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## Maryland Next Generation 9-1-1 Geographic Information Systems Strategic Plan

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### Final Report

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PREPARED NOVEMBER 2019 FOR  
EMERGENCY NUMBER SYSTEMS BOARD  
EMERGENCY COMMUNICATIONS COMMITTEE  
GEOGRAPHIC INFORMATION SYSTEMS WORKGROUP

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## Executive Summary

The State of Maryland, at the individual discretion of the 24 public safety answering points (PSAPs) in the state, is migrating from legacy 9-1-1 technology to Next Generation 9-1-1 (NG9-1-1). Geospatial data provides the foundation for NG9-1-1 systems. Call routing in the existing 9-1-1 environment is performed through tabular data referencing with no dynamic location capabilities. The geospatial data and query capabilities of a geographic information system (GIS) enable highly accurate and dynamic call routing and are critical components of an NG9-1-1 system. In fact, core functionalities such as call routing and location validation rely completely on geospatial processes in an NG9-1-1 environment. NG9-1-1 systems also enable PSAPs to failover 9-1-1 calls and related data to a neighboring PSAP—even one in another state. Therefore, the coordination of geospatial data across Maryland and with neighboring jurisdictions in Pennsylvania, Virginia, West Virginia, Delaware and the District of Columbia is paramount to the success of Maryland's NG9-1-1 system.

To guide the creation, coordination and implementation of geospatial data for NG9-1-1, the Emergency Number Systems Board (ENSB) and the Geographic Information Office (GIO)—herein collectively referenced as the State—commissioned an NG9-1-1 GIS Strategic Plan. This strategic plan provides the framework to assemble a state-level GIS program focused on meeting the needs of the public safety community in Maryland. Although the migration to NG9-1-1 is occurring at the local PSAP level, the State also plays a critical role in developing the implementation path and the final NG9-1-1 architecture for Maryland. Maryland PSAPs have chosen to implement NG9-1-1 individually, which will create a multi-ESInet environment in the state. In the absence of a single ESInet core-services provider, there is no entity responsible for validating data across jurisdictional boundaries. To facilitate this validation and meet the GIS data quality and -accuracy requirements of NG9-1-1, the strategic plan provides recommended actions by the State to successfully position GIS in serving as a foundational component of the statewide NG9-1-1 system. The fundamental recommendations for each focus area identified in this strategic plan are listed below.

### **Guiding strategy: GIS is at the core of NG9-1-1. The migration to NG9-1-1 will require robust geospatial data for every community in Maryland.**

- Local and State GIS leaders should participate actively in the Emergency Communications Committee (ECC) GIS Workgroup as a forum for coordinating GIS efforts across Maryland to achieve a greater return on investment.
- The State should continue to provide a toolset for validating road centerline and address point geospatial data against the legacy automatic location identification (ALI) and master street address guide (MSAG) data tables. It also should update the training program for using this toolset.
- The ECC should maintain a consistent coordination forum to benefit the regions and individual jurisdictions in establishing processes that facilitate more-frequent sharing of geospatial data and incident-response best practices.

- The ECC GIS Workgroup should establish program metrics and milestones to demonstrate and measure progress in the establishment and sustainability of the NG9-1-1 geospatial data program.
- The ECC GIS Workgroup should develop a common geospatial data process across Maryland that will meet or exceed current National Emergency Number Association (NENA) standards, to normalize data collection, maintenance and distribution practices for public-safety-grade data.

**Core principle: GIS programs in Maryland must work in a collaborative environment, both across jurisdictional boundaries and vertically through all levels of government to ensure data integrity across the state. [Section 3]**

- Maryland Department of Information Technology (DoIT) must assess the infrastructure supporting GIS data storage and delivery to confirm alignment with this strategic plan.
- All GIS professionals in Maryland should work with the ECC GIS Workgroup to identify standards-based processes and procedures for data, including extraction and dissemination to PSAP systems.
  - Define and implement NENA-based data standards
  - Design data workflows, from data steward to ESInet, including interdependencies and required schedules and deadlines
  - Develop standard operating procedures (SOPs) for data creation and maintenance
- The GIO must build, maintain, and ensure periodic updates to all databases using, or integrated into, the GIS cross-jurisdictional validation platform.
- The GIO must oversee the development and maintenance of the GIS platform, which will include coordinating with other agencies and providing guidance on the design, review and dissemination of maps and data files. Full system redundancy and elaborate security must be designed into the platform as core components.
- A foundational requirement for the State to assist in the successful integration of GIS data into the 9-1-1 community is to continue supporting public-safety GIS programs at the local level through training and large-scale data-collection programs.
- The GIO should promote the adoption of GIS standards based on the NENA Civic Location Database Exchange Format (CLDXF) standard for all public-safety GIS datasets.
- The GIO should provide education, training and collaboration opportunities for all data stewards to ensure program success.

**Core principle: ENSB will provide to all stakeholders the training, governance and outreach support necessary to successfully prepare geospatial data for the State’s migration to NG9-1-1. This goal only will be achieved through a coordinated effort across all levels of government, led by a skilled team of liaisons focused on the success of all data stewards. [Section 4]**

- Counties are strongly encouraged to seek funding from ENSB for NG9-1-1 costs, and ENSB is equally encouraged to support these funding requests
- The ECC should continue to support a workgroup to guide the NG9-1-1 implementation and update the strategic plan as needed (i.e., the ECC GIS Workgroup)
- The State must create a senior-level position for a 9-1-1 GIS Coordinator to oversee the implementation of the strategic plan
- The State should create a GIS analyst position to work with the GIS Coordinator
- The GIS Workgroup should develop training requirements through coordination with both internal and external stakeholders, to disseminate information, gather user requirements, and raise capability awareness to maintain a sustainable program

**Core principle: GIS data, as the foundation of NG9-1-1, must be standardized across the state and interoperable between PSAPs, between emergency services Internet Protocol (IP) networks (ESInets), and coordinated with neighboring PSAPs in other states to realize a seamless, statewide 9-1-1 system. [Section 5]**

The State must identify the data stewards at every jurisdiction touching a Maryland PSAP and maintain a contact list for use by the local GIS professionals

- The GIS Workgroup must establish a statewide datum that can be leveraged for regional data development
- The GIS Workgroup should define a geospatial data-sharing methodology to reduce data-update lag

The State must provide a toolset for cross-jurisdictional GIS data validation

- The State should create and maintain a centralized catalog of aggregated, statewide NG9-1-1-specific geospatial data

**Core principle: In a multi-ESInet environment, it is vital that all spatial interface (SI) providers utilize GIS data that is validated locally and cross-jurisdictionally. [Section 6]**

- The State should promote the use of the Task Force on Optimal PSAP Architecture (TFOPA) Scorecard at the local level as a progress-tracking tool
- The State should sponsor in-depth assessments within each jurisdiction to ensure NG9-1-1 readiness
- The State should assist the ECC GIS Workgroup in developing templates for interlocal and service level agreements
- The State should fully develop and implement system components to support data regionalization

- The GIO must establish a funding stream for State-sponsored systems

**Core principle: Using national standards as a baseline, Maryland must promote the development and maintenance of GIS data to standards best suited for the multi-ESInet environment in the state in the interest of interoperability. [Section 7]**

- The GIO should actively participate in the ECC GIS Workgroup
- The GIO should share ECC GIS Workgroup needs and successes with other GIS communities, such as the Maryland State Geographic Information Committee (MSGIC)
- The GIO should promote and support the development of standards to the ECC GIS Workgroup

**Core principle: The migration to NG9-1-1 relies upon continuous GIS data creation and maintenance. The professional staff performing the work at the local and state levels will require immediate and sustained funding to ensure GIS data availability. [Section 8]**

- ENSB should formalize the funding request process by implementing a workflow recommending GIO review ahead of submission to ENSB
- The State should release funding request guidance in the form of a white paper that:
  - Describes how to format the request
  - Identifies eligible and ineligible expenses
  - Identifies the required expense breakdown
  - Defines the local matching funds' requirement
  - Describes the project management plan
- The GIS Coordinator shall lead this effort

The further implementation of a large-scale, enterprise-wide capability such as geospatial data collection, aggregation, validation, and dissemination will require a tremendous effort through a phased approach, significant stakeholder coordination and collaboration, and adequate and sustained funding streams. However, by cooperatively implementing a program in adherence to nationally accepted standards, Maryland will position itself in a forward-thinking mode by facilitating interoperable data-sharing practices that create flexibility and sustainability within its 9-1-1 program.

## Glossary of Acronyms

The definitions below were sourced from [NENA-ADM-000.22-2018, 04/13/2018](#), *NENA Master Glossary of 9-1-1 Terminology*.

Acronym	Term	Definition
ALI	Automatic Location Identification	Tabular reference for the current 9-1-1 system. Defines destination PSAP for every landline telephone number and cellular tower
ANI	Automatic Number Identification	Telephone number (TN) associated with the access line from which a call originates
BCF	Border Control Function	Provides a secure entry into the ESInet for emergency calls presented to the network
CAD	Computer-Aided Dispatch	A computer-based system that aids PSAP telecommunicators by automating selected dispatching and record-keeping activities
CLDXF	Civic Layer Data eXchange Format	A set of data elements that describe detailed street address information. All components are spelled out – no abbreviations
DHCP	Dynamic Host Configuration Protocol	A widely used configuration protocol that allows a host to acquire configuration information from a visited network and, in particular, an IP address
DNS	Domain Name System	A globally distributed database for the resolution of host names to numeric IP addresses
DoIT	Department of Information Technology	State-level IT office providing technology solutions that allow the Executive Branch, State Agencies and Coordinating Offices to provide Marylanders with services that enable them to live and work more safely, efficiently and productively
ECC	Emergency Communications Committee	PSAP Directors' Committee within MACo
ECRF	Emergency Call Routing Function	A functional element in an ESInet; the ECRF is a Location to Service Translation (LoST) protocol server where location information (either civic address or geo-coordinates) and a Service Uniform Resource Name (Service URN) serve as input to a mapping function that returns a Uniform Resource Identifier (URI) used to route an emergency call toward the appropriate PSAP for the caller's location or toward a responder agency
ENSB	Emergency Number Systems Board	State oversight body for 9-1-1 in Maryland
ESInet	Emergency Services IP Network	Managed IP network that is used for emergency services communications, and which can be shared by all public safety

Acronym	Term	Definition
		agencies. It provides the IP transport infrastructure upon which independent application platforms and core services can be deployed, including, but not restricted to, those necessary for providing NG9-1-1 services
ESN	Emergency Service Number	A 3- to 5-digit number that represents one or more ESZs
ESRP	Emergency Service Routing Proxy	An i3 <sup>1</sup> functional element that is a SIP proxy server; that the ESRP selects the next-hop routing within the ESInet based on location and policy. There is an ESRP on the edge of the ESInet. There is usually an ESRP at the entrance to an NG9-1-1 PSAP. There may be one or more intermediate ESRPs between them. Originating ESRP: The first routing element within the NGCS. It receives calls from the BCF at the edge of the ESInet. Terminating ESRP: The last ESRP for a call in NGCS
ESRGC	Eastern Shore Regional GIS Cooperative	The ESRGC provides access to GIS technology, data, technical support, and training to the local governments of Maryland's Eastern Shore. The ESRGC is an outreach entity of Salisbury University and is a joint effort between the Mid-Shore Regional Council, the Tri-County Council of the Lower Eastern Shore of Maryland, and the University
ESZ	Emergency Service Zone	A geographical area that represents a unique combination of emergency service agencies (e.g., law enforcement, fire/rescue and emergency medical service) that is within a specified 9-1-1 governing authority's jurisdiction
ETL	Extract, Transform, Load	Three database functions that are combined into one tool to pull data out of one database, properly map the fields to the schema of a second database, and place it into the other database
GIO	Geographic Information Office	The State level division of DoIT tasked with supporting existing and future efforts to improve the quality of GIS in Maryland through coordination and collaboration with the larger GIS community
GIS	Geographic Information System	A system for capturing, storing, displaying, analyzing and managing data and associated attributes which are spatially referenced
i3 PSAP		NENA i3 introduces the concept of an ESInet, which is designed as an IP-based internetwork (network of networks) shared by all agencies that may be involved in any emergency. A PSAP that is capable of receiving IP-based signaling for delivery of emergency calls and for originating calls and is conformant to NENA-STA-010 and other specifications for such PSAPs
IP	Internet Protocol	The method by which data is sent from one computer to another on the ESInet, Internet or other networks

<sup>1</sup> [https://cdn.ymaws.com/www.nena.org/resource/resmgr/standards/NENA\\_STA\\_010.2\\_i3\\_Architectu.pdf](https://cdn.ymaws.com/www.nena.org/resource/resmgr/standards/NENA_STA_010.2_i3_Architectu.pdf)

Acronym	Term	Definition
LIS	Location Information Server	A functional element in an IP-capable originating network that provides locations of endpoints (i.e., calling device)
LVF	Location Validation Function	A functional element in an NGCS that is a LoST protocol server where civic location information is validated against the authoritative GIS database information
MACo	Maryland Association of Counties	MACo is a non-profit and non-partisan organization that serves Maryland's counties by articulating the needs of local government to the Maryland General Assembly. The Association's membership consists of county elected officials and representatives from Maryland's 23 counties and Baltimore City
MDOT	Maryland Department of Transportation	MDOT is an organization comprised of five business units and one Authority. They are: The Secretary's Office, MDOT State Highway Administration, MDOT Maryland Transit Administration, MDOT Motor Vehicle Administration, MDOT Maryland Port Administration, MDOT Maryland Aviation Administration and the Maryland Transportation Authority. This unique approach provides the state's leadership with the ability to develop a coordinated and balanced approach to transportation
MSAG	Master Street Address Guide	Tabular reference for address validation in the current 9-1-1 system. Defines all possible addresses within a jurisdiction
MSGIC	Maryland State Geographic Information Committee	The MSGIC acts to promote coordinated development and efficient use of resources amongst all entities involved in the collection and/or use of spatial data and GIS technologies in Maryland
NCR	National Capital Region	Urban Area Security Initiative defined Congressionally area comprising the District of Columbia and surrounding counties in Maryland and Virginia
NENA	National Emergency Number Association	Standards body for 9-1-1 and NG9-1-1
NG9-1-1	Next Generation 9-1-1	NG9-1-1 refers to an initiative aimed at updating the 9-1-1 service infrastructure in the United States and Canada to improve public emergency communications services in a growingly wireless mobile society
NGCS	Next Generation Core Services	The base set of services needed to process a 9-1-1 call on an ESInet. Includes the ESRP, ECRF, LVF, BCF, Bridge, Policy Store, Logging Services and typical IP services such as DNS and DHCP. The term NGCS includes the services and not the network on which they operate.
OMOC	One Maryland, One Centerline	Program within MDOT to aggregate statewide road centerlines

Acronym	Term	Definition
PRF	Policy Routing Function	That functional component of an Emergency Services Routing Proxy that determines the next hop in the SIP signaling path using a policy
PSAP	Public Safety Answering Point	The entity responsible for receiving 9-1-1 calls and processing those calls according to a specific operational policy
[MDOT] SHA	State Highway Administration	Division of MDOT
SI	Spatial Interface	A standardized interface between the GIS and the functional elements that consume GIS data, such as the ECRF and/or LVF
SIP	Session Initiation Protocol	A protocol specified by the Internet Engineering Task Force (IETF) (RFC3261) that defines a method for establishing multimedia sessions over the internet. Used as the call-signaling protocol in VoIP, NENA i2 and NENA i3
SOP	Standard Operating Procedure	A written directive that provides a guideline for carrying out an activity.
TFOPA	Task Force on Optimal Public Safety Answering Point Architecture	The Federal Task Force directed to study and report findings and recommendations on structure and architecture in order to determine whether additional consolidation of PSAP infrastructure and architecture improvements would promote greater efficiency of operations, safety of life, and cost containment while retaining needed integration with local first responder dispatch and support
VoIP	Voice Over Internet Protocol	Telephone service provided through the internet rather than traditional telephone lines. This includes FIOS™, cable service such as Comcast and Time Warner, and purchased devices like Ooma, Google Voice, or Magic Jack

# 1 Introduction

The delivery of 9-1-1 calls has changed very little since the 1960s, which is in stark contrast to the explosion of technological advances during those same 50 years. Dramatically outpaced by technology, the 9-1-1 system in Maryland no longer can support the complete needs of the public. The Emergency Number Systems Board (ENSB), comprised of 17 members appointed by Maryland’s governor, assists in the coordination of the enhancement of 9-1-1 services at the 24 public safety answering points (PSAPs) in the state. The ENSB is embarking on the arduous task of coordinating the upgrade of 9-1-1 services across the state to Next Generation 9-1-1 (NG9-1-1) with the implementation efforts occurring within the 24 primary PSAPs.

At the foundation of the NG9-1-1 system is geospatial data. Call routing in the existing 9-1-1 system is performed through tabular data referencing with no dynamic location capabilities. The geospatial data and query capabilities of a geographic information system (GIS) enable highly accurate and dynamic 9-1-1 call routing and are critical components of an NG9-1-1 system. In fact, core functionalities such as call routing and location validation completely rely on geospatial processes in the NG9-1-1 environment. Additionally, NG9-1-1 systems enable PSAPs to failover 9-1-1 calls and related data to a neighboring PSAP—even one in another state. Therefore, the coordination of geospatial data across the state and with the neighboring jurisdictions in Pennsylvania, Virginia, West Virginia, Delaware and the District of Columbia is paramount to the success of Maryland’s NG9-1-1 system.

Success depends largely on the creation, maintenance, and distribution of highly accurate geospatial data by all PSAPs and requires consideration regarding cross-jurisdictional and regional coordination of address points and ranges, road centerlines, and PSAP polygons or boundaries. Local data must be aggregated to create statewide, then regional, and ultimately national data that supports NG9-1-1. Therefore, it is necessary to establish statewide standards, workflows, policies, and agreements to govern the development and maintenance of the geospatial data supporting NG9-1-1.

## 1.1 Purpose

This strategic plan provides the framework to augment the state-level GIS program and provides focus on meeting the needs of the public safety community in Maryland. Although the migration to NG9-1-1 is occurring at the local PSAP level, the State also plays a key role in developing the implementation path and the final NG9-1-1 architecture for providing and validating across jurisdictional boundaries, NG9-1-1 GIS data in Maryland. This strategic plan is designed to incorporate and enhance current state and local assets and capabilities. To meet the requirements of NG9-1-1, the strategic plan provides recommended actions to successfully position GIS in serving as a foundational component of the statewide NG9-1-1 system. The fundamental areas addressed in this strategic plan include:

- Funding
- Staffing
- Collaboration/data sharing
- Outreach/education
- Security
- Maintenance

This strategic plan must remain flexible as efforts transition from implementation to maintenance. As key milestones are completed, the strategic plan must be updated. The contextual overview of the goals provided herein is meant to foster collaboration among the many state, regional and local GIS programs providing data and support to the statewide NG9-1-1 system. Maryland continues to solicit the involvement of the GIS community in the development and maintenance of NG9-1-1 data and this strategic plan. The ENSB, the State, local PSAPs and the GIS community across Maryland have come together and continue to build an implementation plan detailing requirements, methodologies, and agreements necessary for a successful implementation of the statewide NG9-1-1 system.

## 1.2 Role of GIS in NG9-1-1

GIS data, analysis and visualization are necessary to ensure that every emergency call in the NG9-1-1 environment is delivered to the correct PSAP, the caller is located accurately, the appropriate response is dispatched based on proximity and availability, and the responders are dispatched to the emergency location expeditiously. Local and State GIS programs are being tasked with a level of service never before experienced in Maryland. The successful implementation of NG9-1-1 in Maryland not only is dependent on GIS data preparation but also continuous, timely data refinement and constant maintenance.

GIS data is used before 9-1-1 services are needed in service address validation. Traditionally, the master street address guide (MSAG) was used to validate address information when new telephone service was requested. In the legacy 9-1-1 system, the MSAG also is queried to determine the PSAP associated with an address, which is provided by the automatic location identification (ALI) record for each telephone service account. The road centerline GIS dataset, when properly attributed with address ranges, will fulfill these functions in an NG9-1-1 system. Updates to the road network, the addition of new roads, and changes to existing roads must be updated locally and should be validated for cross-jurisdictional integrity using the State-provided system within 72 hours, according to industry recommendations.

In the NG9-1-1 environment, the routing of a call to the proper PSAP depends on the accuracy of the GIS data. The location address associated with the customer record (landline service) or the latitude and longitude information provided by the customer device—voice over Internet Protocol (VoIP) and cellular service) is geocoded by the GIS and a query of a point (the caller's location) in a polygon (the PSAP boundary) is performed on the GIS data to determine the destination PSAP for each 9-1-1 call. To complete this process, the GIS road centerlines, address points and PSAP boundary datasets must be kept current.

Once a call reaches the PSAP, the 9-1-1 Specialist will be provided with a map showing the location of the caller. Roughly 80 percent of 9-1-1 calls in Maryland are placed from mobile phones. These calls are located with varying degrees of accuracy, making the GIS map a key tool in dispatching responders to the proper location. Not only must a PSAP have available GIS data within its PSAP boundary, but this data also should include the surrounding areas, because the caller actually may be in a location beyond the PSAP boundary and as a result may be using landmarks to describe their location to the telecommunicator.

Further, NG9-1-1 allows for the alternate routing of 9-1-1 calls to other PSAPs. It is imperative that telecommunicators in these PSAPs have access to GIS data in and beyond their respective boundaries

and the boundaries of supported PSAPs to allow for alternative call-routing. All modifications to the address points and road centerlines must be validated for cross-jurisdictional integrity and updated to the emergency services IP network (ESInet) within the same 72-hour timeframe.

### 1.3 Background

Maryland jurisdictions have robust GIS programs staffed by talented practitioners. These programs have been creating and maintaining geospatial data to support planning, engineering, utilities, public safety, and other agencies for decades. While public safety GIS-supporting programs currently exist in Maryland, at the local, regional, and state levels, these programs vary widely in maturity, capability, and focus, which makes the NG9-1-1 migration effort more challenging. In addition, the decentralized nature of these programs further complicates future public safety GIS efforts throughout the state.

In recent years, Maryland jurisdictions have taken steps to advance preparations for NG9-1-1. In 2016, the National Capital Region (NCR), which includes the Maryland counties of Charles, Frederick, Montgomery, and Prince George's, received a grant to populate the spatial interface (SI) components of NG9-1-1. Through this grant and with support from Mission Critical Partners (MCP) and Digital Data Technologies, Inc (DDTi), all four counties achieved a 98 percent or better match between their geospatial data and their respective MSAG table. The match rate between these two datasets directly correlates with the level of preparedness of the geospatial data, for incorporation into the SI within the ESInet.

The ENSB funded a similar effort statewide in 2017. MCP worked with all 23 counties and the City of Baltimore to secure current road centerline data and ALI tables from each. MCP then provided each jurisdiction with an initial match rate between its ALI and geospatial data. While no jurisdiction scored a perfect match, the results were promising. The average match rate across the state was just under 66 percent. Removing from the average the jurisdictions with ALI errors from Verizon, which resulted in match rates of zero, the statewide average was 79 percent.

Upon conclusion of this project 18 months later, more than 50 percent of the jurisdictions in the state achieved a match rate higher than 90 percent. MCP continues to monitor the progress of the individual match rates as every jurisdiction continues to improve its data.

It is important to note that the match rates between the geospatial data and the MSAG and ALI data serve to identify when the geospatial data is ready for implementation in an NG9-1-1 environment. The end goal of data validation is to ensure that the GIS data is of sufficient accuracy to fulfill the current roles of both the MSAG and ALI tables. Achieving a match rate above 98 percent between the GIS data and either tabular dataset is a good indicator of GIS data readiness. However, a 98 percent match rate between both the MSAG and the ALI tables and the GIS data is strongly encouraged before placing the GIS data into service within the SI. Finally, all three datasets and the match rates between them must be maintained throughout the NG9-1-1 implementation to support parallel operations, i.e., both legacy and spatial call routing, until SI testing is complete.

## 1.4 Partners

For decades, Maryland has relied upon the geospatial community to promote collaboration, coordination and communication amongst municipal, county, regional, state and federal geospatial-related activities. This community has established and fostered strong partnerships that have been paramount in the efforts initiated through the migration to NG9-1-1.

In particular, several organizations assisted the jurisdictions throughout this process, including:

### **Maryland State Geographic Information Office**

Maryland has a comprehensive, well-organized GIS program that provides geospatial data, services and support to state, regional, county and municipal agencies. Housed within the Maryland Department of Information Technology (DoIT), the current Geographic Information Office (GIO) Officer is a voting member of the ENSB. The GIO offers support through the coordination and aggregation of GIS data, services and software to assist jurisdictions in their efforts to create, edit, and maintain geospatial data for NG9-1-1.

### **One Maryland One Centerline**

The Maryland Department of Transportation – State Highway Administration (MDOT SHA) continues to work with the counties to create a single, standardized, statewide road centerline file. The One Maryland One Centerline (OMOC) project team had the forethought to include NG9-1-1 data requirements in the data model for the road centerlines. The results from the OMOC project have positively influenced the match rate between the road centerlines and the ALI database. In addition to the standardization of the road centerline data, the OMOC project also resulted in edge-matched road centerlines across the state, and with many border jurisdictions in neighboring states.

### **Maryland State Geographic Information Committee**

Formed in 1992, the Maryland State Geographic Information Committee (MSGIC) is an assemblage of local, regional, state, academic, and private-sector GIS professionals with the common goal of promoting coordinated development and efficient use of resources amongst all entities involved in the collection and use of geospatial data and GIS technologies in Maryland.<sup>2</sup> Within MSGIC there are several subcommittees, including a group focused exclusively on NG9-1-1. This subcommittee, among other responsibilities, serves as a clearinghouse for questions, answers, and peer support for topics encountered on the path to NG9-1-1 readiness. Many GIS professionals in Maryland have leveraged this network of peers to identify best practices to improve their individual GIS readiness initiatives.

### **NG9-1-1 GIS Workgroup**

The Emergency Communications Committee (ECC)—under the Maryland Association of Counties (MACo), Emergency Managers Affiliate—has chartered a GIS Workgroup focused on the promotion of NG9-1-1 standards, geospatial data development, and coordination of NG9-1-1-focused GIS efforts and communication between the GIS professionals and the PSAP directors. The placement of GIS within this structure gives the workgroup access to far-reaching and valuable capabilities to advance its efforts. This includes the ability to develop contract materials independent of the vendor community.

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<sup>2</sup> <http://msgic.org/history-structure/>

As Maryland moves toward the implementation of NG9-1-1, communication between and amongst the GIS and PSAP communities is more important than ever. Initially, the effort to foster these relationships was the responsibility of the individual jurisdictions and was not consistent across the state. These partnerships assist with formalizing the link that solidifies and homogenizes the communications between these two communities and is necessary to achieve success in NG9-1-1.

## 1.5 Role of the Strategic Plan

The strategic plan was developed to establish an actionable framework of objectives and to provide guidance regarding the advancement of geospatial services in public safety across Maryland at the state level. The State must support the local PSAPs as they implement NG9-1-1 services. The strategic plan identifies areas where the State can provide services to enhance the local GIS capability to provide high quality, regionally validated GIS data to the NG9-1-1 effort. This framework includes recommendations regarding:

- Governance and leadership for the NG9-1-1-related GIS data effort
- Stakeholder engagement and coordination
- Reinforcement of the need for statewide data sharing
- Spatial data steward outreach and training
- Staffing
- Program evaluation

This strategic plan is a charter for the development of GIS data to support public safety; as such, it must remain flexible as the program transitions from implementation to maintenance. As key milestones are completed, the strategic plan must be updated with new goals, milestones and guidance. The contextual overview of the goals provided herein is meant to foster collaboration among the many state, regional and local GIS programs providing data and support to the statewide NG9-1-1 migration.

The implementation of NG9-1-1 throughout Maryland is at the discretion of the local PSAPs. Likewise, the ownership of geospatial data supporting NG9-1-1 is the responsibility of the local GIS authority. However, the impacts, both positive and negative, of geospatial data quality reach far beyond the individual PSAP. Coordination of geospatial data across the state and with neighboring jurisdictions in Pennsylvania, Virginia, West Virginia, Delaware and the District of Columbia is paramount to the success of the NG9-1-1 migration. It, therefore, is necessary to establish statewide standards, workflows, policies and agreements to govern the development and maintenance of the geospatial data supporting NG9-1-1. This strategic plan provides the State with clarity regarding the governing structure implemented by the local jurisdictions through the ECC, and the role of the State in supporting the compatibility of statewide NG9-1-1 geospatial data.

## 2 Next Generation Geographic Information System

**Guiding strategy: GIS is at the core of NG9-1-1. The migration to NG9-1-1 will require robust geospatial data for every community in Maryland.**

The next generation core services (NGCS) within the ESInet will play host to a wide range of geospatial services replacing the tabular MSAG and ALI databases. This same data also will support the advanced alternate-routing capabilities between the jurisdictions' ESInets. The figure below depicts the spatially enabled components of the NGCS.

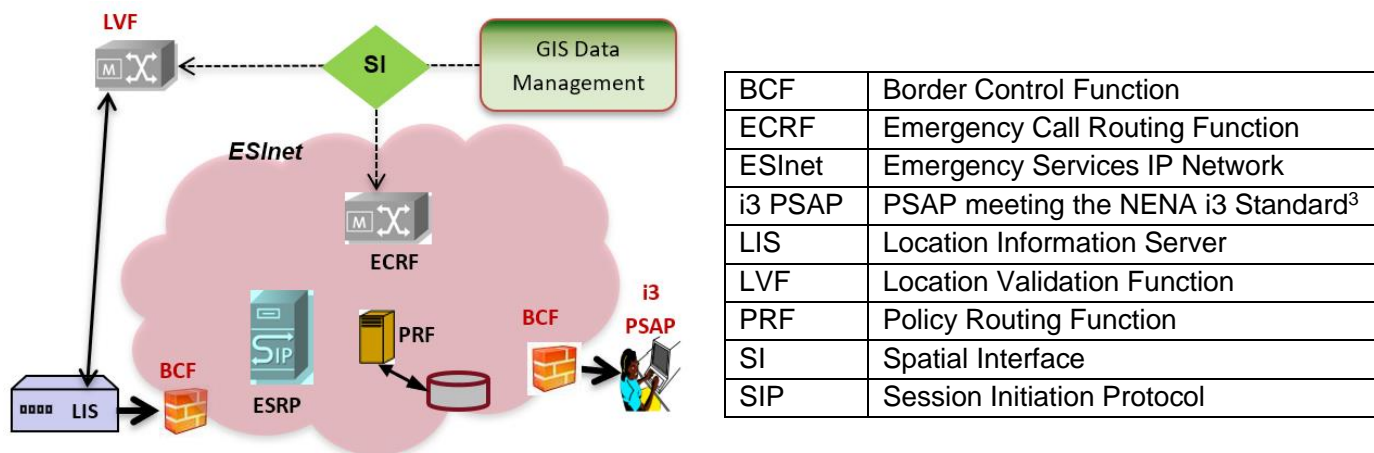


Figure 1: Spatially enabled components of the NGCS and acronym table

The State funded a baseline assessment of the GIS readiness within each PSAP. This assessment provided a high-level picture of GIS data quality, in terms of NG9-1-1 standards compliance, at each PSAP. The individual readiness scores for each PSAP then can be rolled into a statewide matrix. The results of this assessment were used to develop the statewide readiness scorecard discussed in Section 2.1 below.

## 2.1 NG9-1-1 GIS Readiness

The Federal Communications Commission (FCC)'s Task Force on Optimal Public Safety Answering Point Architecture (TFOPA) created a high-level NG9-1-1 Readiness Scorecard<sup>4</sup> as one way to measure PSAP readiness for NG9-1-1. The TFOPA model assumes a transition from Legacy (today's 9-1-1) to National End State (every PSAP has successfully implemented NG9-1-1). For the purpose of this strategic plan, the model has been shortened to the Regional End State representing Maryland as a single region. The overall score for NG9-1-1 readiness averaged across all jurisdictions in the state, places Maryland in the Transitional state according to the TFOPA model. A breakdown of the individual modules used to identify this score, as well as identified gaps, are provided in the figure below.

<sup>3</sup> [https://cdn.ymaws.com/www.nena.org/resource/resmgr/standards/NENA\\_STA\\_010.2\\_i3\\_Architectu.pdf](https://cdn.ymaws.com/www.nena.org/resource/resmgr/standards/NENA_STA_010.2_i3_Architectu.pdf)

<sup>4</sup> [https://transition.fcc.gov/pshs/9-1-1/TFOPA/TFOPA\\_WG2\\_Supplemental\\_Report-120216.pdf](https://transition.fcc.gov/pshs/9-1-1/TFOPA/TFOPA_WG2_Supplemental_Report-120216.pdf)

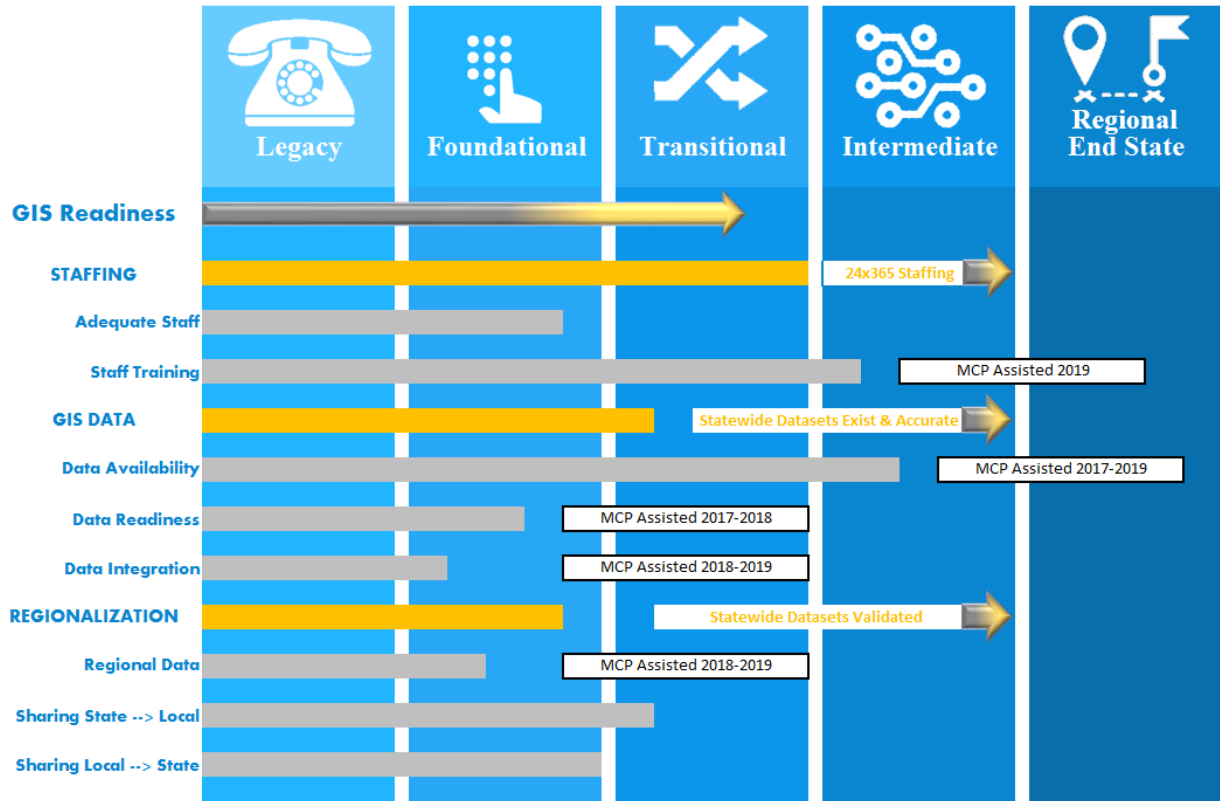


Figure 2: Statewide TFOPA GIS Readiness Scorecard

Several requirements are assessed to determine a jurisdiction's TFOPA score:

- Many GIS programs in Maryland do not meet the required staffing levels to support the needs of NG9-1-1 along with their existing duties<sup>5</sup>.
- GIS staff in Maryland must be well-trained in the use of GIS and geospatial data and possess a good understanding of the spatial needs of NG9-1-1.
  - Training will be necessary on specific needs regarding the ESInet solution once an ESInet provider is selected.
  - Training on NG9-1-1 data requirements will be necessary for newly hired staff to meet the time demands of NG9-1-1 geospatial data updates.
- The initial data assessment revealed that all jurisdictions in Maryland currently maintain the required road centerline and address data for NG9-1-1. Most jurisdictions still need to develop emergency service zone (ESZ) data. PSAP boundaries exist and usually follow jurisdiction lines, although many jurisdictions have completed or are in the process of completing PSAP boundary adjustments with neighboring jurisdictions.
  - Further effort is needed for promoting data sharing among jurisdictions and with Maryland.

<sup>5</sup> Maryland statewide staffing study preliminary results *To be updated with link to staffing plan(s) once finalized*

- Polygon data will need further development to incorporate logical call routing based on historical PSAP operations in some jurisdictions.
- Existing geospatial data in the majority of jurisdictions is not NG9-1-1 ready.
  - Road centerlines do not snap between jurisdictions.
  - Match rates between MSAG/ALI/GIS are below the requisite 98 percent.
  - Edge-matching of polygon datasets between neighboring jurisdictions is not complete.
  - A statewide dataset exists for road centerline and address point data but only is updated monthly.
- Other than the road centerline and address point data, geospatial data in Maryland exists as jurisdictional data.
  - Lack of need has prevented regional efforts for geospatial data aggregation.
  - No sponsor exists for aggregated PSAP or ESZ data.
- Data regionalization has been promoted within the NCR, Baltimore Metropolitan Council of Governments (BMC), and the Eastern Shore Regional GIS Cooperative (ESRGC).
  - The governance is in place for these jurisdictions to work together on polygon data.
  - Some jurisdictions have not begun data regionalization.
- State efforts to make data available to local jurisdictions exist and are widely used
- Local jurisdictions are willing to share with Maryland though there is no universally adopted system for doing so that encompasses all of the required NG9-1-1 geospatial data.

The desire is for all jurisdictions in the state and Maryland itself to reach the Regional End State in all categories.

## 2.2 NG9-1-1 Requirements of GIS Data

Calls to 9-1-1 across Maryland are routed to the PSAP using a tabular reference of phone number and address. To determine the correct PSAP to which the call should be routed, a selective router uses the phone number to query the automatic number identification (ANI) table to find the address in the ALI table and then searches the MSAG for the emergency service number (ESN) related to that address. Wireless calls are routed the same way, with each cell tower antenna sector being assigned a pseudo ANI (pANI) value.

In contrast, NG9-1-1 utilizes the flexible capabilities of geospatial location services to route 9-1-1 calls based on the caller's location, i.e., a point placed within a PSAP boundary, also known as a polygon. The point-in-polygon query results in a call being routed to the proper PSAP.

When roads are added, boundaries changed, or response zones modified, the GIS data is updated. These updates are applied to the ESInet, which uses this geospatial data for call routing within the emergency call routing function (ECRF). The interactions of spatially enabled data within the GIS permit NG9-1-1 systems to deliver service to a technologically advanced public. The tabular ALI, which is limited to addressable locations, is replaced by the GIS data. Because the ECRF uses the actual physical location of the caller to

route the 9-1-1 call to the correct PSAP, changes in the real world are more quickly translated to the 9-1-1 realm than with the legacy approach.

Maryland PSAPs have chosen to implement NG9-1-1 individually, which will create a multi-ESInet environment in the state. The State must support interoperability between ESInet GIS data by aggregating jurisdictional GIS data into statewide point, line and polygon datasets and then validating the aggregated data for topological integrity and overlap regarding attribution between neighboring jurisdictions. In the absence of a single ESInet core-services provider, there is no entity responsible for validating data across jurisdictional boundaries. To facilitate this validation and meet the GIS data-quality and -accuracy requirements of NG9-1-1, the State must be prepared to offer these validation services to the jurisdictions.

## 2.3 Goals/Objectives

The State, the ECC and the GIS community have identified several key initiatives that will guide the implementation of a robust and widely beneficial geospatial program in support of the larger public safety mission, as follows:

- Local and State GIS leaders should actively participate in the ECC GIS Workgroup as a forum for coordinating GIS efforts across Maryland to achieve a greater return on investment.
- The State should continue to provide a toolset for validating road centerline and address point geospatial data against the legacy ALI and MSAG data tables and update the training program for the use of this toolset.
- The ECC should maintain a consistent coordination forum to benefit the regions and individual jurisdictions in establishing processes that facilitate more frequent sharing of geospatial data and incident response best practices.
- The ECC GIS Workgroup should establish program metrics and measurable milestones to demonstrate and measure progress in the establishment and sustainability of the NG9-1-1 geospatial data program.
- The ECC GIS Workgroup should develop a common geospatial data process across Maryland that will meet or exceed current National Emergency Number Association (NENA) standards, to normalize data collection, maintenance and distribution practices for public-safety-grade data.

## 3 State-Level Coordination

**Core principle: GIS programs in Maryland must work in a collaborative environment, both across jurisdictional boundaries and vertically through all levels of government to ensure the integrity of NG9-1-1 GIS data across the state.**

The implementation of NG9-1-1 in Maryland is at the discretion of the individual PSAPs. Likewise, the development and maintenance of GIS data also is the responsibility of each jurisdiction. The Maryland PSAPs are creating a network of ESInets across the state that must integrate to provide statewide 9-1-1 services. To assist in the endeavor, the State must provide access to hardware, software, and best practices in an environment fostering collaboration. Equally important, the environment also should provide secondary validation tools to ensure GIS data readiness by validating GIS data across jurisdictional boundaries and between ESInet providers. The state-level coordinating body for 9-1-1 in Maryland is the ENSB.

### 3.1 Organizational Structure

The ENSB does not have the organizational capacity to directly manage NG9-1-1 GIS efforts at the state and local jurisdictions. The governance of statewide NG9-1-1 geospatial data development and maintenance should be driven by the same professionals responsible for providing highly accurate and continuously maintained geospatial data to support NG9-1-1. To achieve this governance, the GIS professionals and PSAP directors in Maryland formed a workgroup under MACo's ECC.

The benefits of aligning this workgroup with MACo and ECC are plentiful. Most importantly, this alignment provides a direct link between the PSAP leadership and GIS professionals and allows the workgroup to operate within government procurement rules by holding closed-door meetings.

The GIO works closely with the ENSB, the ECC GIS Workgroup and the GIS community at large to assist in the management of NG9-1-1 geospatial data efforts and state-level information technology (IT) needs. DoIT will continue to govern the use of State IT resources for the benefit of state and local agencies.

### 3.2 State Level GIS

The Maryland State Geographic Information Office openly has expressed willingness to participate in the NG9-1-1 geospatial data development process. The State already provides a clearinghouse for geospatial data through MD iMAP<sup>6</sup>, Maryland's open data portal. The State is not in the data development, maintenance or quality assurance/quality control (QA/QC) business. It can, however, serve as a collection and distribution hub for statewide geospatial data supporting the SI and computer-aided dispatch (CAD) systems.

The implementation of GIS data for NG9-1-1 will require a great deal of coordination, training, facilitation, outreach, and support. These functions are best provided at a state level. A GIS management position to support NG9-1-1 does not exist within ENSB or at the state level. The GIO is willing to work with the ENSB to manage a contracted position focused on providing these services to the ENSB and its stakeholder community, to further the success of the NG9-1-1 implementation and ensuring continued operation.

### 3.3 Local and Regional GIS

The authority over addressing resides in the county, and sometimes in incorporated municipalities within these counties. In Maryland, with the exception of Baltimore City, 9-1-1 services are provided by the

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<sup>6</sup> <http://doit.maryland.gov/support/Pages/GIS.aspx>

county. ENSB has chosen to associate NG9-1-1 GIS services with PSAP boundaries. Therefore, the responsibility of coordinating with any GIS entities within incorporated municipalities in Maryland lies with the counties. In some cases, city GIS capabilities exceed those at the county level. Regardless, geospatial data must be aggregated to the county level before being validated for cross-jurisdictional integrity and then submitted to the NGCS provider for deployment.

### 3.4 9-1-1 PSAP Directors

The ECC is the coordinating body for PSAP leadership across Maryland. The GIS community should participate actively in the ECC GIS Workgroup. This assembly of GIS professionals is open to all county GIS employees. The ECC GIS Workgroup offers a conduit to 9-1-1 leaders in Maryland and neighboring states for resolving issues concerning intra- and interstate geospatial data development. The ECC also serves as the formal standards and policy body for local input into all NG9-1-1 GIS-related documentation being developed for statewide adoption.

### 3.5 Emergency Number Services Board

Maryland's governor in 2008 added a position on the ENSB for a GIS representative. In addition to being a voting member of the ENSB, the GIO provides GIS subject-matter expertise. The GIO actively seeks input from the ECC GIS Workgroup, as well as the statewide GIS community. Jurisdictions seeking funding for GIS projects are encouraged to communicate with the GIO prior to bringing requests before the ENSB.

### 3.6 Goals/Objectives

The success of statewide NG9-1-1 cannot be realized without Maryland coordinating the efforts of the 24 PSAPs toward a common goal. To facilitate the migration, the State should:

- Assess infrastructure supporting GIS data storage and delivery to confirm alignment with this strategic plan.
- Work with the ECC GIS Workgroup to identify standards-based processes and procedures for data, including extraction and dissemination to PSAP systems.
  - Define and implement NENA-based data standards
  - Design data workflows, from data steward to PSAP, including interdependencies and required schedules and deadlines
  - Develop standard operating procedures (SOPs) for data creation and maintenance
- Build, maintain, and ensure periodic updates to all databases using, or integrated into, the GIS cross-jurisdictional validation platform.
- Oversee the development and maintenance of the GIS platform, which will include coordinating with other agencies and providing guidance on the design, review and dissemination of maps and data files. Full system redundancy and elaborate security must be designed into the platform as core components.

- A foundational requirement for the successful integration of GIS into the 9-1-1 community is to continue supporting public-safety GIS programs at the local level through training and large-scale data-collection programs such as statewide orthoimagery and light detection and ranging (LIDAR).
- Promote the adoption of GIS standards based on the NENA Civic Location Database Exchange Format (CLDXF) standard for all public-safety GIS datasets.
- Provide education, training and collaboration opportunities for all data stewards to ensure program success.

## 4 Staffing and Training

**Core principle: ENSB will provide to all stakeholders the training, governance and outreach support necessary to successfully prepare geospatial data for the State’s migration to NG9-1-1. This goal only will be achieved through a coordinated effort across all levels of government, led by a skilled team of liaisons focused on the success of all data stewards.**

The talented staff supporting GIS data at the local, regional and state levels have a passionate desire to work together—within the community and across disciplines—to ensure the success of NG9-1-1. The most accurate data is sourced from local jurisdictions. NG9-1-1 necessitates that this data be aggregated at the state level and then distributed regionally. However, no entity exists within Maryland that is tasked with coordinating GIS data aggregation efforts.

### 4.1 Staffing

Implementing the recommendations in this strategic plan at the State level will require a great deal of management and oversight. It is critical that the ENSB and the GIO work to hire a 9-1-1 GIS Coordinator to coordinate the GIS community’s participation in the NG9-1-1 implementation. This person may require the assistance of additional staff to provide support to the local jurisdictions. This team will be responsible for program oversight and leading the coordination, development and ongoing maintenance of the statewide public-safety GIS data efforts. A positive relationship between the ENSB, the GIO, the ESInet provider(s) and the local data stewards is critical to the success of the NG9-1-1 migration across the state.

#### 4.1.1 GIS Coordinator

The 9-1-1 GIS Coordinator, in addition to coordinating all NG9-1-1 GIS data efforts across Maryland, will be the champion for implementing the recommendations in this strategic plan. The 9-1-1 GIS Coordinator also will:

- Work closely with DoIT and the Geographic Information Office to promote relationships between local and state-level GIS programs
- Participate in ECC GIS Workgroup meetings to foster relationships between GIS and PSAP leadership
- Oversee the outreach liaisons

- Implement NENA GIS-related standards at the state level
- Manage 9-1-1-funded GIS grants to local jurisdictions
- Report GIS status to the GIO for presentation to the ENSB
- Recommend items to be brought before the ENSB, ECC, and other coordination boards

#### 4.1.2 GIS Outreach Liaisons to the Jurisdictions

NG9-1-1 will rely heavily on the support of local data stewards to create and maintain geospatial data that supports NG9-1-1. To further this effort, the State must maintain open communications with, and provide support to, the GIS staff at the jurisdictions. To this end, it may become necessary to create an outreach program that includes staffing multiple liaison positions to assist the 9-1-1 GIS Coordinator. The liaison will:

- Report to the GIS Coordinator
- Work with jurisdictions to acquire data, coordinate multijurisdictional projects, report issues back to the GIS Coordinator, and ensure that standards are met
- Provide education and outreach to PSAP staff and local data stewards to garner buy-in
- Provide instant return on investment (ROI) in the form of 9-1-1 data availability and coordinated project cost savings
- Assist in developing and maintaining interoperability between ESInets

Such programs have been implemented successfully in many states, including Virginia.

## 4.2 Training

The complexities of developing GIS data for NG9-1-1, combined with the requirements it places on non-GIS staff, will require immediate and ongoing training for staff, external data stewards of peripheral datasets, and the larger NG9-1-1 stakeholder community, to ensure that all participants are well-versed in the importance of their positions in the program, as well as the impact of their individual and combined successes and failures upon the life-safety mission. To this end, the State should establish training recommendations and raise the awareness of all stakeholders to ensure that new GIS capabilities are properly utilized, and additional user requirements are met.

This training and technical assistance should include disseminating information to counties, other state agencies, and PSAPs looking to minimize duplication of geospatial data creation and maintenance efforts or to provide a level of information sharing for the State's benefit. As Maryland begins the transition to NG9-1-1, the State and the ECC GIS Workgroup should begin to focus on the longer-term strategic initiatives for geospatial data development and sustainment.

## 4.3 Goals/Objectives

The following are the initiatives that Maryland should undertake to support the State's GIS-related staffing and training goals:

- Create a workgroup to guide the NG9-1-1 implementation and update the strategic plan as needed.
- Create a senior-level position for the 9-1-1 GIS Coordinator, who will oversee the implementation of the strategic plan.
- Create a GIS analyst position to work with the GIS Coordinator.
- Develop training requirements through coordination with both internal and external stakeholders, to disseminate information, gather user requirements, and raise capability awareness to maintain a sustainable program.

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### Achieved

*The State, PSAP leadership and local GIS experts founded the GIS Work Group within the MACo construct and under the auspices of the Emergency Communications Committee, providing a bidirectional conduit for information sharing between GIS and PSAP subject-matter experts.*

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## 5 Geographic Information System Data

**Core principle: GIS data, as the foundation of NG9-1-1, must be standardized across the state and interoperable between PSAPs, between ESInets, and coordinated with neighboring PSAPs in other states to realize a seamless, statewide 9-1-1 system.**

NG9-1-1 in Maryland will function in a multiple ESInet environment. Local GIS data will be tested by the ESInet SI provider prior to populating or updating the SI. Depending on the ESInet provider selected, testing on aggregated datasets for cross-jurisdictional errors may be performed by the ESInet provider. In cases where multiple ESInet providers exist, this error testing must be performed by the State.

The aggregated and validated GIS data will serve two distinct functions in the Maryland NG9-1-1 ecosystem. First, as described above, the NG9-1-1 call-routing function will use this data to connect an emergency caller with the correct PSAP for dispatching emergency services.

Secondly, this aggregated data provides expanded capabilities to PSAPs. For instance, they will be able to identify the location of misrouted 9-1-1 calls, provide call-taking and dispatching assistance to neighboring PSAPs, and share resources during large-scale, localized events. Failover call routing to mitigate high call volumes and disabled PSAPs, or to accommodate planned outages, is an added benefit of NG9-1-1. The ability to failover to another PSAP is contingent upon, among other operational limitations, the availability of map data in the CAD system. By making a statewide dataset available, Maryland creates an environment in which the PSAPs can enlist assistance from any technologically capable partner, or group of partners, to provide failover services.

### 5.1 Road Centerline

GIS road centerline arc-node topology is associated with attribute data containing information on street names, address ranges, jurisdictional boundaries, and other attributes. The road centerline layer, when

properly developed and maintained, is an integral part of any public safety GIS due to its versatility, which enables its use in the following functions:

- Querying and geocoding of civic addresses based on dual (left/right) address ranges
- Tactical map display
- Map and attribute viewing
- Map production
- Location and driving directions
- Integration of network topology to enable vehicle routing and drive-time analysis
- Integration of spatially related attributes for advanced applications, including those focused on public safety, asset management, planning, utilities, and public works

See NENA-STA-006.1-2018, *NENA Standard for NG9-1-1 GIS Data Model*, Section 3.1 for full attribution requirements.<sup>7</sup>

Maryland has a very progressive road centerline program sponsored by the MDOT SHA that, with the extensive support of local GIS efforts, has resulted in a statewide centerline file complete with robust, NG9-1-1-compliant attribution. Road centerlines usually are the most difficult piece of the geospatial data puzzle to implement. The OMOC project is of great benefit to the NG9-1-1 effort. However, while the OMOC program staff and MDOT SHA leadership understand the importance of NG9-1-1 geospatial data, the OMOC program is sponsored through transportation funds. If the focus of this effort shifts or if NG9-1-1 attributes no longer can be maintained due to funding limitations or scope tightening, the value of this data to NG9-1-1 is reduced or completely dissolved. The ENSB should enter into a service level agreement (SLA) with the MDOT SHA to ensure the continued support of this program.

Summary of NG9-1-1 road centerline requirements:

- Centerlines shall be continually updated with new construction or changes in the existing road network
- Centerlines shall represent all public and addressed private roads
- Attributes shall be accurate, complete and standardized. Maryland must decide on:
  - Use of punctuation
  - Postal abbreviations or CLDXF standard
  - Update the OMOC dataset to meet the current NENA schema
- Road names shall conform to the legal names as assigned by the local addressing authority
- Centerline segments with no addressing along one or both sides, including small connector pieces, shall have zeroes entered into the relevant address range fields

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[https://cdn.ymaws.com/www.nena.org/resource/resmgr/standards/nena-sta-006\\_ng9-1-1\\_gis\\_dat.pdf#page=21&zoom=100,0,278](https://cdn.ymaws.com/www.nena.org/resource/resmgr/standards/nena-sta-006_ng9-1-1_gis_dat.pdf#page=21&zoom=100,0,278)

- Roads representing the border of maintenance responsibility should contain address ranges for the side of road within the jurisdiction. The ranges for the side of road outside the maintenance jurisdiction should contain zeroes to avoid possible overlapping ranges between adjoining jurisdictions. Interlocal agreements may be necessary to accommodate special situations
- Each centerline segment shall share an exact start or end node with another centerline segment unless it is a dead end
- Road centerline segments shall be split at:
  - Intersections with state, county, city, ESZ and PSAP boundaries
  - Intersection with another road segment
  - Change in primary road name

The SLA between the ENSB and the MDOT SHA should contain these requirements as well as the full list of the required, optional and conditional fields as found in Appendix A.

## 5.2 PSAP Boundary

The primary use for the PSAP boundary data layer is to route NG9-1-1 calls. The PSAP boundary layer may contain one or many polygons. Each PSAP boundary defines the geographic area of a PSAP that has primary responsibilities for emergency response requests. This layer is used by the ECRF to perform a geographic query to determine the PSAP to which an emergency response request is routed. This is done using NGCS based upon the geographic location of the request, which is provided by a civic address, geographic coordinate or geodetic shape, as defined in NENA-STA-010.2-2016, *NENA Detailed Functional and Interface Standards for the NENA i3 Solution*. (See also NENA-STA-006.1-2018, *NENA Standard for NG9-1-1 GIS Data Model*, Section 3.3 for full attribution requirements.<sup>8</sup>)

The PSAP boundary may not follow jurisdictional lines in Maryland and with neighboring states. PSAP leadership will determine the most logical alignment of the PSAP boundary to minimize call transfers. In some cases, first-due and mutual-aid agreements may make it logical to draw a PSAP boundary based on access point (ingress) and not local tax parcel. Waterways as boundaries can be affected by swift-water rescue capabilities rather than waterway centerlines. Political and financial implications do not necessarily define PSAP boundaries in the same manner as they do legal boundaries.

The key factor in developing PSAP boundary files is coordination with neighboring PSAPs. There cannot exist any overlaps or gaps between PSAP boundaries in Maryland. It is imperative for efficient call routing that these polygons snap together across the state and with jurisdictions in the neighboring states. Responsibility for topologically correct PSAP boundaries across Maryland shall be with the State. All ESInet providers shall utilize only the State-provided aggregated PSAP boundary GIS dataset as recommended by the ECC GIS Workgroup and approved by the ECC.

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<sup>8</sup>

[https://cdn.ymaws.com/www.nena.org/resource/resmgr/standards/nena-sta-006\\_ng9-1-1\\_gis\\_dat.pdf#page=21&zoom=100,0,278](https://cdn.ymaws.com/www.nena.org/resource/resmgr/standards/nena-sta-006_ng9-1-1_gis_dat.pdf#page=21&zoom=100,0,278)

A full list of the required, optional and conditional fields for the PSAP boundary is found in Appendix A. The Maryland PSAP boundary resolution SOP developed by the ECC GIS Workgroup and adopted by the ECC is provided as Appendix B.

### 5.3 Emergency Service Zone

Once the PSAP boundary for a jurisdiction is finalized, individual response areas can be defined for each emergency service—law enforcement, fire/rescue, and emergency medical services (EMS). An ESZ is a geographic area that combines all three emergency service entities. These zones will snap to the PSAP boundary and will define the response to all addresses within the smaller boundary.

The ECRF uses the ESZ boundary layer to do the following:

- Perform a geographic query to determine which emergency service providers are responsible for providing service to a location in the event a selective transfer is desired
- Direct an emergency incident data document to a secondary PSAP for dispatch
- Display the responsible agencies at the PSAP

ESZ boundaries also are used by PSAPs to identify the appropriate emergency response to be dispatched. Each ESZ boundary layer may contain one or more polygon boundaries that define the primary emergency services for that geographic area. There must be a separate ESZ boundary layer for each type of service.

The set of ESZ boundaries must include, at a minimum, the following:

- Law enforcement
- Fire/rescue
- EMS

ESZ boundary information is different from the other layers described in this document because the following template is reused for each emergency service type:

- The 9-1-1 authority may maintain the ESZ boundary layer as a combined or single layer for each emergency service
- However, when exchanging ESZ boundary information in an NG9-1-1 environment, such boundaries must be exchanged as individual layers for each emergency service type (e.g., one for law enforcement, one for fire/rescue, and one for EMS)
- The State shall collect, aggregate and disseminate the ESZ boundary GIS datasets

See NENA-STA-006.1-2018, *NENA Standard for NG9-1-1 GIS Data Model*, Section 3.4 for full attribution requirements.<sup>9</sup> A full list of the required, optional and conditional fields for the ESZ is found in Appendix A.

## 5.4 Address Point

Site/structure address points ideally represent the location of a site or structure or the location of access to a site or structure. They also can represent landmarks. Address points provide the ability to locate sites that otherwise may not geocode correctly using the road centerline data; areas of unusual addressing (e.g., odd-number addresses on the even-number side of the road centerlines and vice versa); and other areas where sufficient road centerline data is not available. Some addressable locations may be problematic near boundaries. In cascading geocoders (multiple, stacked location services), address points are the first tier for location matching.

The address number, street name, and place name attributes (e.g., incorporated municipality, unincorporated community, neighborhood community) in the address points layer should be consistent with the address number range, street name, and left/right place name attribute combinations found in the road centerline layer.

While there may be address point data available, this data may not be in the standardized format of this schema. Geospatial data providers should be working toward developing and maintaining the address point data described in NENA-STA-006.1-2018, *NENA Standard for NG9-1-1 GIS Data Model*. See Section 3.2 for full attribution requirements.<sup>10</sup>

NENA INF-014.1, *Development of Site/Structure Address Point GIS Data for 9-1-1*, provides guidance on address point development to support 9-1-1 service.<sup>11</sup> Address points can be used for location validation, call routing, and reverse 9-1-1. The ENSB recognizes the significant benefit of requiring this valuable dataset in the NG9-1-1 implementation.

Summary of site/structure address point requirements:

- Address points shall be continually updated.
- Address points shall, at a minimum, represent all public and private addressable structures.
- Address point attributes shall be accurate, complete and standardized.
- Abbreviations for street prefix, suffix and type shall follow the selected standard for road centerlines.

A full list of the required, optional and conditional fields for address points is found in Appendix A.

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<sup>9</sup> [https://cdn.ymaws.com/www.nena.org/resource/resmgr/standards/nena-sta-006\\_ng9-1-1\\_gis\\_dat.pdf](https://cdn.ymaws.com/www.nena.org/resource/resmgr/standards/nena-sta-006_ng9-1-1_gis_dat.pdf)

<sup>10</sup>

[https://cdn.ymaws.com/www.nena.org/resource/resmgr/standards/nena-sta-006\\_ng9-1-1\\_gis\\_dat.pdf#page=21&zoom=100,0,278](https://cdn.ymaws.com/www.nena.org/resource/resmgr/standards/nena-sta-006_ng9-1-1_gis_dat.pdf#page=21&zoom=100,0,278)

<sup>11</sup> [https://c.ymcdn.com/sites/www.nena.org/resource/resmgr/Standards/NENA-INF-014.1-2015\\_SSAP\\_INF.pdf](https://c.ymcdn.com/sites/www.nena.org/resource/resmgr/Standards/NENA-INF-014.1-2015_SSAP_INF.pdf)

## 5.5 Provisioning Boundary

This polygon layer defines the area of geospatial data-provisioning responsibility, with no unintentional gaps or overlaps. The provisioning boundary must be agreed to by all adjoining data-provisioning providers. This provisioning boundary polygon layer can be used by an ECRF to facilitate the exclusion of erroneous features that lie beyond the boundary and for geoprocessing purposes. The State shall be the definitive source for the provisioning boundary GIS dataset; as such, it shall aggregate and then validate individual jurisdictions' boundaries. When provisioning data for an ECRF and Location Validation Function (LVF) through the SI, a 9-1-1 authority or its designee must include only geospatial data for its geographic area of responsibility and must ensure that the data includes coverage for the entire extent of that area.

See NENA-STA-006.1-2018, *NENA Standard for NG9-1-1 GIS Data Model*, Section 3.5 for full attribution requirements.<sup>12</sup>

## 5.6 Topology Checks

Topological integrity must be maintained within the PSAP boundary and between neighboring PSAPs. Topology checks must be performed on:

- Address Points
  - Point falls within provisioning polygon
  - No duplicate point exists within jurisdiction
  - No duplicate point exists within neighboring jurisdiction
- Road Centerlines
  - Each centerline segment must share an exact begin or end node with another centerline segment
  - If segments intersect without begin or end nodes, (e.g., overpasses or underpasses) a street intersection is not established
  - For routing purposes and intersection lookup purposes, each intersection must be split (i.e., broken).
  - Centerline segments must be split at all true (i.e., grade-level) intersections
  - Line (road) segments shall be split at intersections and ESZ boundaries. Road segments can be split at city and country boundaries as well
  - Consider splitting at railroad tracks and streams for intersection searches
  - The centerline segments should be drawn in the direction of increasing addresses, which is not necessarily the same as the direction of travel
- PSAP, Provisioning, ESZ Polygons
  - Polygons must not overlap neighboring polygons within the same feature class
  - No gaps between polygons within the same feature class
  - ESZ polygons must completely nest within the PSAP polygon

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<sup>12</sup> [https://cdn.ymaws.com/www.nena.org/resource/resmgr/standards/nena-sta-006\\_ng9-1-1\\_gis\\_dat.pdf](https://cdn.ymaws.com/www.nena.org/resource/resmgr/standards/nena-sta-006_ng9-1-1_gis_dat.pdf)

The above processes and more are described in detail in NENA 02-014, *GIS Data Collection & Maintenance*.<sup>13</sup> See also NENA 71-501, *NENA Information Document for Synchronizing Geographic Information System Databases with MSAG & ALI*, Version 1, Section 3.1 for full topology requirements.<sup>14</sup>

## 5.7 Goals/Objectives

The following are initiatives Maryland should undertake to support the statewide development of geospatial data for NG9-1-1:

- Identify the data stewards at every jurisdiction
- Establish statewide datum that can be leveraged for regional data development
- Define a geospatial data-sharing methodology to reduce data-update lag.
- Provide a toolset for geospatial data validation
- Create a centralized catalog of NG9-1-1-specific geospatial data

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### **Completed**

*The GIS Work Group selected the World Geodetic System 1984 (WGS84) in accordance with NENA guidance.*

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### **Commencing**

*The GIO has provided the 1Spatial toolset for data validation. Training is being provided to facilitate the export, transform, and load (ETL) process for geospatial data provisioning and exchange.*

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## 6 Next Generation Core Services Spatial Interface Transition Plan

**Core principle: In a multi-ESInet environment, it is vital that all SI providers utilize the same GIS data, that the GIS data is validated locally and cross-jurisdictionally.**

The SI houses the ECRF and LVF within the NGCS. The core geospatial data listed in Section 5, GIS Data, above must exist, with the proper attribution, and be validated for proper topology, continuity, and compliance with schema standards prior to resolving the GIS, ALI, and MSAG datasets.

The figure below provides a high-level roadmap from legacy 9-1-1 location services to NG9-1-1 GIS. Details for each step in the GIS readiness progression are provided in Section 6.1.

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<sup>13</sup>

[https://c.ymcdn.com/sites/www.nena.org/resource/collection/C74A8084-E3BD-405D-93C2-48AFCFA5B490/NENA\\_02-014-v1\\_GIS\\_Data\\_Collection\\_and\\_Maintenance.pdf](https://c.ymcdn.com/sites/www.nena.org/resource/collection/C74A8084-E3BD-405D-93C2-48AFCFA5B490/NENA_02-014-v1_GIS_Data_Collection_and_Maintenance.pdf)

<sup>14</sup> [https://cdn.ymaws.com/www.nena.org/resource/resmgr/Standards/NENA\\_71-501\\_GIS\\_MSAG\\_ALI\\_05-.pdf](https://cdn.ymaws.com/www.nena.org/resource/resmgr/Standards/NENA_71-501_GIS_MSAG_ALI_05-.pdf)

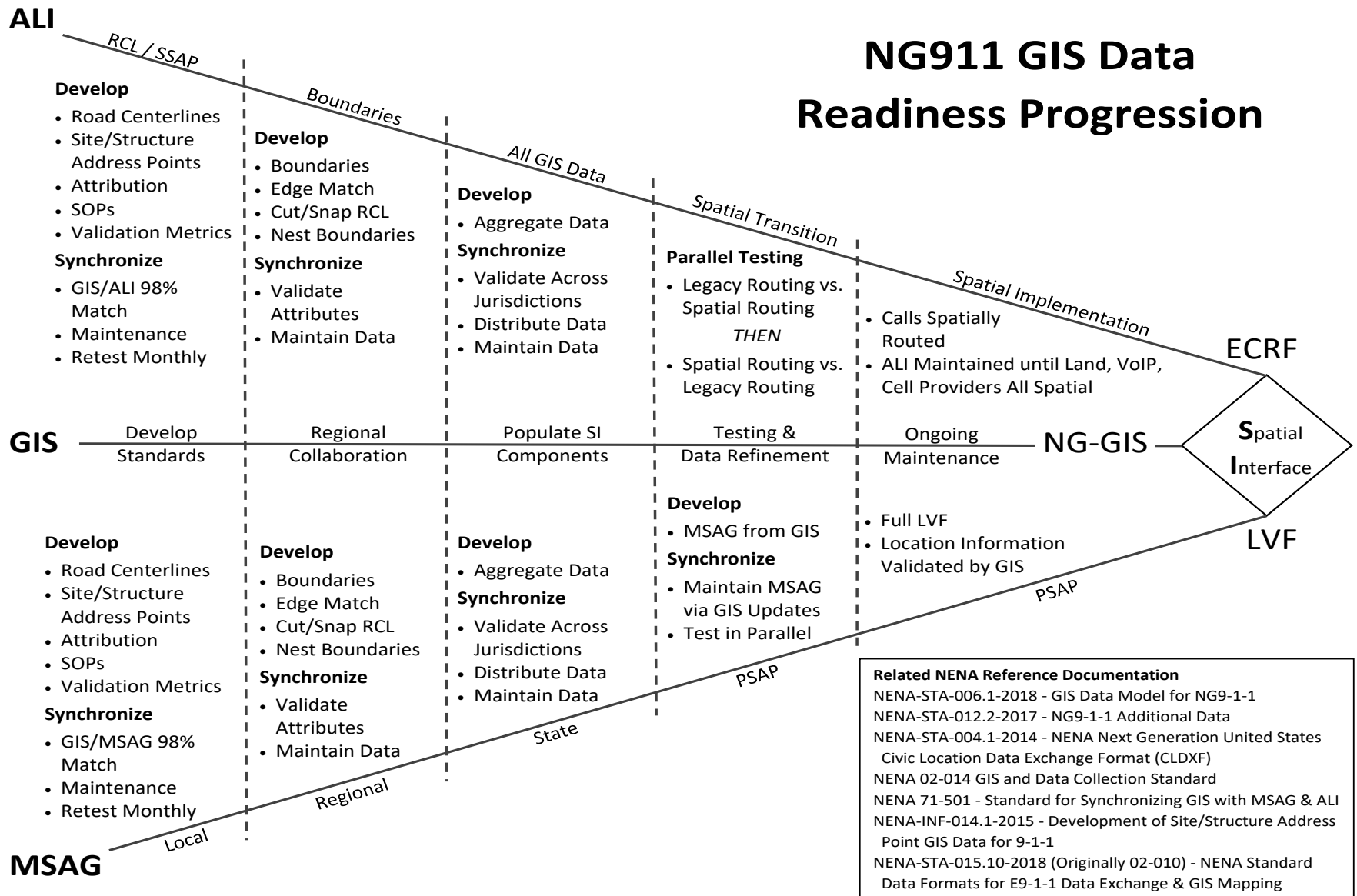


Figure 3: Legacy to NG9-1-1 Progression

## 6.1 GIS Data Readiness

The GIS community in Maryland is very much detail oriented and understands the significant requirements placed on geospatial data that supports NG9-1-1. It is vital to the success of the NG9-1-1 transition that the readiness metrics are fully vetted, and the individual statuses are validated prior to greenlighting the replacement of legacy, tabular location-validation (MSAG) and call-routing (ALI) data.

It is the role of the 9-1-1 GIS Coordinator to monitor the progress of all PSAPs as they prepare the GIS data for the SI. The State should maintain a report card for each jurisdiction highlighting the status of each component of the NG9-1-1 migration.

### 6.1.1 Interlocal Cooperative Agreements

While the importance of providing geospatial data to the State in support of NG9-1-1 has been adopted widely in Maryland, it still is necessary to ensure the continuity of this process through staff or leadership turnover or any other issue that could hinder the same. It is incumbent upon jurisdictions to determine the requisite type of agreement for each situation. A memorandum of understanding (MOU) may be appropriate for reassigning addressing authority to another level of government while a service level agreement (SLA) between two entities is recommended for the maintenance and operations of key system components performing core services, such as data or address validation.

### 6.1.2 Interstate Cooperative Agreements

Jurisdictions sharing a boundary with another state should ensure the continuation of mitigation solutions through the implementation of MOUs, SLAs, interlocal agreements (ILAs), and other agreements as appropriate. These agreements will bridge the gap between the two states regarding standards, policies and other differences.

While each jurisdiction must comply with its respective host state's NG9-1-1 requirements, the same is true concerning the neighboring state's standards and policies, to ensure interoperability where necessary to support the life-safety mission. The 9-1-1 GIS Coordinator will be a resource for jurisdictions requiring assistance in developing these agreements with neighboring states.

## 6.2 Functional Operation

As jurisdictions come online with NG9-1-1, the initial upload of and subsequent updates to the geospatial data in the SI all must pass through a series of validations prior to being placed in service. The path for geospatial data for NGCS is outlined in the figure below.

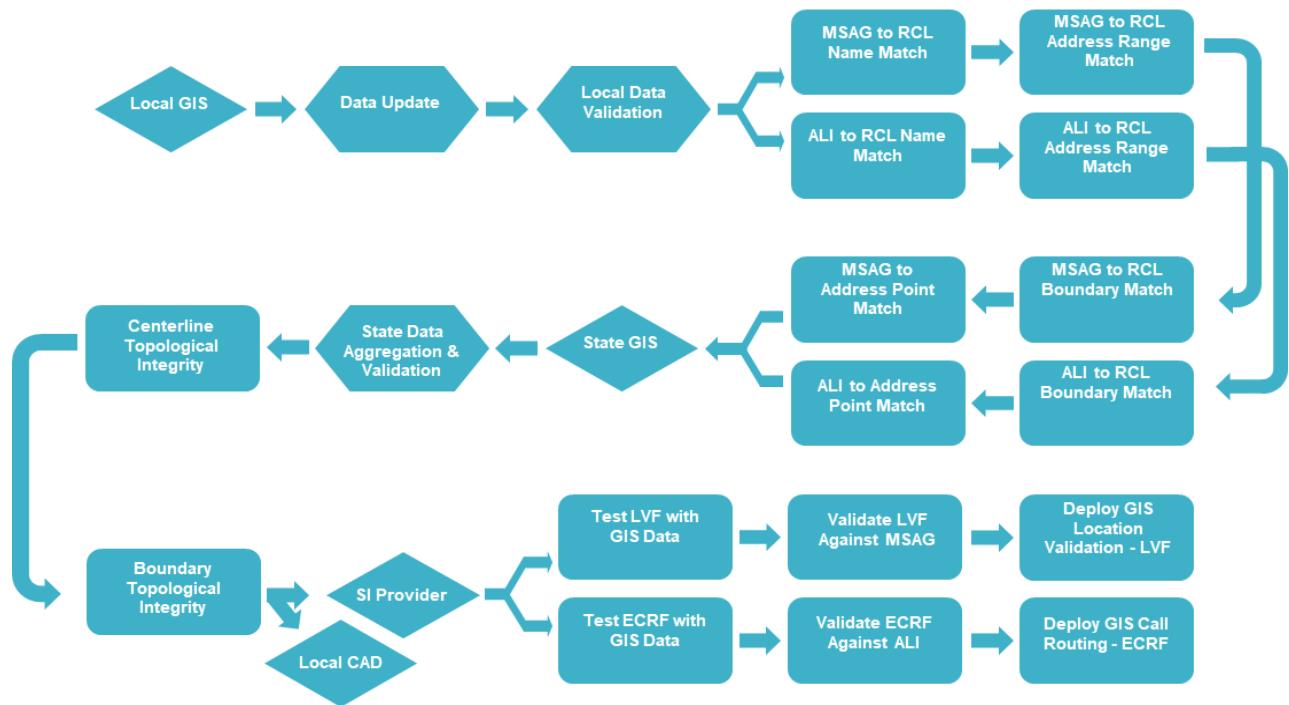


Figure 4: GIS Data Preparation Process<sup>15</sup>

The local data is validated against the ALI and MSAG legacy datasets. If these tests are successful, the data is passed to the State for aggregation and validation against the same data from the other jurisdictions in Maryland. Once the topological integrity of the data is validated, the aggregated data is made available to the jurisdictions for inclusion in local CAD systems and to the SI provider for population of the SI components.

To provide the State Data Validation Services listed above, Maryland will need to implement additional hardware and software.

### 6.3 Goals/Objectives

Maryland should undertake the following initiatives to support the transition to NGCS within the 24 PSAPs in the state:

- Promote the use of the TFOPA Scorecard at the local level as a progress tracking tool
- Sponsor in-depth assessments within each jurisdiction to ensure NG9-1-1 readiness
- Assist the ECC GIS Workgroup in developing templates for interlocal and service level agreements
- Fully develop and implement system components to support data regionalization
- Establish a funding stream for State-sponsored systems

<sup>15</sup> Local discretion exists for the use of Boundary Topology in CAD as it may create confusion for responders because it does not strictly follow “legal boundary definitions.”

## 7 Standards, Procedures, Best Practices

**Core principle: Using national standards as a baseline, Maryland must promote the development and maintenance of GIS data to standards best suited for the multi-ESInet environment in the state in the interest of interoperability.**

Maryland is on the cusp of NG9-1-1 implementation statewide. While some standards, SOPs, workflows, and best practice documents do exist, the State will need to develop most of these in-house.

### 7.1 Adoption of National Standards

NENA has released and continues to author new standards for the geospatial data supporting NG9-1-1. Maryland will use these standards as a baseline for the statewide standards. In some cases, the ECC GIS Workgroup will adopt the NENA standard(s) outright. However, it may be necessary to further develop the NENA standard(s) into a functional specification for Maryland. In these cases, the ECC GIS Workgroup must be careful to continue to at least meet the NENA standard(s).

### 7.2 Workflows

The ECC GIS Workgroup already has developed a workflow for resolving PSAP boundaries across the state. This document is provided in Appendix B. It will be necessary to develop similar documentation for many of the operational processes pertaining to GIS. Such needs will become apparent as the jurisdictions begin implementing NGCS and addressing interoperability. The ECC GIS Workgroup should identify these opportunities and seek to standardize the process across the state.

### 7.3 Standard Operating Procedures

Standardized processes, such as the GIS Data Preparation Process identified in Figure 4 above, will require formal documentation to reinforce the need for compliance by all jurisdictions. The identification of these opportunities and the authoring of a document are key functions of the ECC GIS Workgroup.

### 7.4 Best Practices

Northern Virginia (NoVA) and the Maryland jurisdictions within the National Capital Region (NCR) have an 18-month head start on the NG9-1-1 migration. The ECC GIS Workgroup should work closely with the NoVA and NCR jurisdictions to capture the best practices identified during the migration to NG9-1-1 within those jurisdictions.

### 7.5 Goals/Objectives

Maryland should undertake the following initiatives to support GIS and PSAP staff in standardizing geospatial implementation and operations across the state:

- Actively participate in the ECC GIS Workgroup
- Share ECC GIS Workgroup needs and successes with other GIS communities, such as the MSGIC

## 8 Funding

**Core principle: The migration to NG9-1-1 relies upon continuous GIS data creation and maintenance. The professional staff performing the work at the local and state levels will require immediate and sustained funding to ensure GIS data availability.**

In April 2018, Maryland Governor Larry Hogan signed a bill into law that authorized the formation of the Commission to Advance Next Generation 9-1-1 Across Maryland (the Commission) under the auspices of MACo. The Commission was established to address the issues associated with the implementation of NG9-1-1 technology, which includes funding.

### 8.1 Initiatives

The Commission tirelessly worked during fall 2018 to submit a report to Maryland's governor and general assembly on December 1, 2018. The report made 23 recommendations to assist Maryland in moving toward NG9-1-1, such as expanding enabling legislation for the ENSB to include eligible expenses. These expenses include the following:

- Recurring costs for maintenance and sustainment of NG9-1-1
- Establishing guidance and support for NG9-1-1 integration and interoperability
- GIS implementation and related data development
- Training, certification, quality assurance, and recertification standards for PSAPs and 9-1-1 specialists

### 8.2 Goals/Objectives

The addition of GIS data to the eligible funding requests creates an opportunity for every jurisdiction to develop the requisite geospatial datasets necessary to implement NG9-1-1. In fact, funding requests already are being brought before the ENSB for GIS-related projects supporting NG9-1-1.

Maryland should undertake the following initiatives to support local funding requests made by the 24 PSAPs in the state:

- Formalize the funding request process by implementing a workflow recommending GIO review ahead of submission to the ENSB
- Release funding request guidance in the form of a white paper that:
  - Describes how to format the request
  - Identifies eligible and ineligible expenses
  - Identifies the required expense breakdown
  - Defines the local matching funds' requirement

- Describes the project management plan
- The GIS Coordinator shall lead this effort

## 9 Summary

The migration to NG9-1-1 at the 24 PSAPs in Maryland, will vary by jurisdiction but will follow the same general path. To complete the migration, several milestones exist that can be used to measure progress and ensure success. At the end of each section in this strategic plan is a list of goals and objectives to be undertaken or supported by the Maryland State Geographic Information Office, DoIT, the ECC GIS Workgroup and the ENSB, or a combination thereof.

As local PSAPs transition their respective 9-1-1 systems to an NG9-1-1 environment, the increasing demand, and the requirement for a robust GIS capability is amplified. The State recognizes GIS as a powerful data-sharing and decision-support tool that will serve the 9-1-1 community.

The further implementation of a large-scale, enterprise-wide capability such as geospatial data collection, aggregation, validation, and dissemination will require a tremendous effort through a phased approach, significant stakeholder coordination and collaboration, and adequate and sustained funding streams. However, by cooperatively implementing a program in adherence to nationally accepted standards, Maryland will position itself in a forward-thinking mode by facilitating interoperable data-sharing practices that create flexibility and sustainability within its 9-1-1 program.

## Appendix A: Maryland Statewide Next Generation 9-1-1 Schema

The Maryland State schema for each of the geospatial datasets is defined below. Although jurisdictions will not be required to adopt these schemas exactly as shown, it is necessary for local geospatial data to be complete and compatible with the State schema. An export, transform, and load (ETL) process can be used by the local jurisdiction to prepare geospatial data for the ESInet.

The attribute M-C-O in the tables below, per NENA standards are defined as:

- M Mandatory – data must exist and be properly attributed.
- C Conditional – data must exist if certain conditions exist within a PSAP or between neighboring PSAPs.
- O Optional – the inclusion of the data is at the behest of the PSAP.

The attribute type in the tables below, per NENA standards are defined as:

- P Printable ASCII character text fields in Esri geodatabase feature classes.
- E UTF-8 restricted (defined by PSAP) text fields in Esri geodatabase feature classes.
- D Date fields in Esri geodatabase feature classes.
- N Numeric short-integer or long-integer fields in Esri geodatabase feature classes. Note that the address number must be a long-integer field.
- F Floating (decimal) in Esri geodatabase feature classes with fractional values within a specific range. For latitude and longitude values, six significant digits are preferred when available.
- U A Uniform Resource Identifier (URI) as described in Section 7.9 of the NENA NG9-1-1 GIS Data Model NENA-STA-006.1,

Required Fields: Road Centerline

Attribute	Field Name	M-C-O	Type	Width
Source of Data (Discrepancy Agency ID)	DiscrpAgID	M	P	75
Date Updated	DateUpdate	M	D	--
Effective Date	Effective	O	D	--
Expiration Date	Expire	O	D	--
Road Centerline NENA Globally Unique ID	RCL_NGUID	M	P	254
Left Address Number Prefix	AdNumPre_L	C	P	15
Right Address Number Prefix	AdNumPre_R	C	P	15
Left FROM Address	FromAddr_L	M	N	6
Left TO Address	ToAddr_L	M	N	6
Right FROM Address	FromAddr_R	M	N	6
Right TO Address	ToAddr_R	M	N	6
Parity Left	Parity_L	M	P	1

Attribute	Field Name	M-C-O	Type	Width
Parity Right	Parity_R	M	P	1
Street Name Pre Modifier	St_PreMod	C	E	15
Street Name Pre Directional	St_PreDir	C	P	9
Street Name Pre Type	St_PreTyp	C	E	50
Street Name Pre Type Separator	St_PreSep	C	E	20
Street Name	StreetName	M	E	60
Street Name Post Type	St_PosTyp	C	E	50
Street Name Post Directional	St_PosDir	C	P	9
Street Name Post Modifier	St_PosMod	C	E	25
Legacy Street Name Pre Directional	LSt_PreDir	C	P	2
Legacy Street Name	LSt_Name	C	P	75
Legacy Street Name Type	LSt_Type	C	P	4
Legacy Street Name Post Directional	LStPosDir	C	P	2
ESN Left	ESN_L	C	P	5
ESN Right	ESN_R	C	P	5
MSAG Community Name Left	MSAGComm_L	C	P	30
MSAG Community Name Right	MSAGComm_R	C	P	30
Country Left	Country_L	M	P	2
Country Right	Country_R	M	P	2
State Left	State_L	M	P	2
State Right	State_R	M	P	2
County Left	County_L	M	P	40
County Right	County_R	M	P	40
Additional Code Left	AddCode_L	C	P	6
Additional Code Right	AddCode_R	C	P	6
Incorporated Municipality Left	IncMuni_L	M	E	100
Incorporated Municipality Right	IncMuni_R	M	E	100
Unincorporated Community Left	UnincCom_L	O	E	100
Unincorporated Community Right	UnincCom_R	O	E	100
Neighborhood Community Left	NbrhdCom_L	O	E	100
Neighborhood Community Right	NbrhdCom_R	O	E	100
Postal Code Left	PostCode_L	C	P	7
Postal Code Right	PostCode_R	C	P	7
Postal Community Name Left	PostComm_L	C	P	40
Postal Community Name Right	PostComm_R	C	P	40
Road Class	RoadClass	O	P	15
One-Way	OneWay	O	P	2
Speed Limit	SpeedLimit	O	N	3
Validation Left	Valid_L	O	P	1
Validation Right	Valid_R	O	P	1

Required Fields: Site Structure Address Point

Attribute	Field Name	M-C-O	Type	Width
Source of Data (Discrepancy Agency ID)	DiscrpAgID	M	P	75
Date Updated	DateUpdate	M	D	--
Effective Date	Effective	O	D	--
Expiration Date	Expire	O	D	--
Site NENA Globally Unique ID	Site_NGUID	M	P	254
Country	Country	M	P	2
State	State	M	P	2
County	County	M	P	40
Additional Code	AddCode	C	P	6
Additional Data URI	AddDataURI	C	U	254
Incorporated Municipality	Inc_Muni	M	E	100
Unincorporated Community	Uninc_Comm	O	E	100
Neighborhood Community	Nbrhd_Comm	O	E	100
Address Number Prefix	AddNum_Pre	C	P	15
Address Number	Add_Number	C	N	6
Address Number Suffix	AddNum_Suf	C	P	15
Street Name Pre Modifier	St_PreMod	C	E	15
Street Name Pre Directional	St_PreDir	C	P	9
Street Name Pre Type	St_PreTyp	C	E	50
Street Name Pre Type Separator	St_PreSep	C	E	20
Street Name	St_Name	C	E	60
Street Name Post Type	St_PosTyp	C	P	50
Street Name Post Directional	St_PosDir	C	P	9
Street Name Post Modifier	St_PosMod	C	E	25
Legacy Street Name Pre Directional	LSt_PreDir	C	P	2
Legacy Street Name	LSt_Name	C	P	75
Legacy Street Name Type	LSt_Type	C	P	5
Legacy Street Name Post Directional	LStPostDir	C	P	2
ESN	ESN	C	P	5
MSAG Community Name	MSAGComm	C	P	30
Postal Community Name	Post_Comm	C	P	40
Postal Code	Post_Code	C	P	7
ZIP Plus 4	Post_Code4	O	P	4
Building	Building	O	P	75
Floor	Floor	O	P	75
Unit	Unit	O	P	75
Room	Room	O	P	75

Attribute	Field Name	M-C-O	Type	Width
Seat	Seat	O	P	75
Additional Location Information	Addtl_Loc	O	P	225
Complete Landmark Name	LandmkName	C	E	150
Mile Post	Mile_Post	C	P	150
Place Type	Place_Type	O	P	50
Placement Method	Placement	O	P	25
Longitude	Long	O	F	-
Latitude	Lat	O	F	-
Elevation	Elev	O	N	6

Required Fields: PSAP Boundary

Attribute	Field Name	M-C-O	Type	Width
Source of Data (Discrepancy Agency ID)	DiscrpAgID	M	P	75
Date Updated	DateUpdate	M	D	--
Effective Date	Effective	O	D	--
Expiration Date	Expire	O	D	--
Emergency Service Boundary NENA Globally Unique ID	ES_NGUID	M	P	254
State	State	M	P	2
Agency ID	Agency_ID	M	P	100
Service URI	ServiceURI	M	U	254
Service URN	ServiceURN	M	P	50
Service Number	ServiceNum	O	P	15
Agency vCard URI	AVcard_URI	M	P	254
Display Name	DsplayName	M	P	60

Required Fields: ESZ Boundary

Attribute	Field Name	M-C-O	Type	Width
Source of Data (Discrepancy Agency ID)	DiscrpAgID	M	P	75
Date Updated	DateUpdate	M	D	--
Effective Date	Effective	O	D	--
Expiration Date	Expire	O	D	--
Emergency Service Boundary NENA Globally Unique ID	ES_NGUID	M	P	254
State	State	M	P	2
Agency ID	Agency_ID	M	P	100
Service URI	ServiceURI	M	P	254
Service URN	ServiceURN	M	P	50
Service Number	ServiceNum	O	P	15
Agency vCard URI	AvCard_URI	M	P	254
Display Name	DsplayName	M	P	60

## Appendix B: Maryland NG9-1-1 GIS Boundary Resolution Workflow

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**MissionCriticalPartners**  
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## Maryland NG9-1-1 GIS Boundary Resolution Workflow

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### Final Report

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PREPARED APRIL 2019 FOR  
MARYLAND ASSOCIATION OF COUNTIES  
EMERGENCY MANAGEMENT AFFILIATE  
EMERGENCY COMMUNICATIONS COMMITTEE

[MissionCriticalPartners.com](http://MissionCriticalPartners.com)

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## Background

The migration to Next Generation 9-1-1 (NG9-1-1) technology in the State of Maryland (State) requires the resolution of public safety answering point (PSAP) boundaries between jurisdictions in the state and between Maryland jurisdictions and those in neighboring states. The Maryland Department of Information Technology (DoIT) seeks to assist the 24 Maryland PSAPs and each county's geographic information system (GIS) staff in developing seamless boundary coverage across the state and region. This workflow details the process necessary to achieve this goal.

It is vital to remember that the resultant PSAP boundary polygons are for 9-1-1 call routing only. They are not legal-ownership boundaries nor are they representative of tax parcels, legal descriptions, or other political boundaries. The PSAP boundary polygons will be used to route 9-1-1 calls to the appropriate PSAP. The end goal is to minimize call transfers and related delays in the delivery of emergency services. PSAP leadership will make boundary decisions based on historical response experience, first-due and mutual-aid agreements, and other logistical factors.

## Setup

There are 97 unique boundaries surrounding the 24 Maryland PSAPs. A little more than one half of these boundaries are shared with counties in neighboring states. The Commonwealth of Pennsylvania also is ready to begin resolving its 16 boundary lines with Maryland. The Northern Virginia (NoVA) counties are establishing a workflow to be used internally as they work through their in-state boundary resolutions. Work on the 14 common boundary lines between Maryland and NoVA can begin immediately after the completion of the latter's internal-resolution project. Finally, Maryland's PSAP boundaries with West Virginia, Virginia, Pennsylvania, and Delaware also must be resolved. DoIT and the PSAP directors are working to identify contacts within each of these states with whom GIS staff can collaborate on boundary resolution.

Maryland jurisdictions should begin work immediately on the 47 boundaries internal to the state. The first step is for jurisdictions sharing a boundary to select a starting dataset.

## Source Data

Jurisdictions are encouraged to work collaboratively to determine the best starting point for developing a seamless boundary. The table below lists several data sources available for use as a foundation. Once a baseline dataset is selected, the GIS staff can begin editing the linework to address any errors or inaccuracies.

Table 1: Data Sources

Source	Description	Link
DoIT Line File	Developed specifically for this project from the MD iMAP county boundary file.  Exploded polygon, broken at each jurisdictional boundary.	<a href="#">LINK</a>
MD iMAP County Boundary	Maryland GIS Data Catalog County Boundary file	<a href="#">LINK</a>
U.S. Census County Boundary	1:500,000 resolution. Census TIGER File dataset	<a href="#">LINK</a>

The NENA standard for NG9-1-1 geospatial data is WGS84. This is supported through in-depth research by the National Geospatial-Intelligence Agency (NGA).<sup>16</sup> The GIS Workgroup adopted WGS84 as the official standard for geospatial data development and maintenance.

### Collaboration Tools

DoIT has deployed a collaboration space on ArcGIS Online (AGOL) to support this effort. The AGOL portal allows each jurisdiction to upload a PSAP boundary line file editable by both jurisdictions.<sup>17</sup> Supporting geospatial data from the MD iMAP data catalog also can be added. While this tool does enable remote editing of the data, the standard best practice for resolving PSAP boundaries requires the PSAP leadership and GIS staff from both jurisdictions to be in the same room. Boundary drawing decisions depend on operational considerations such as mutual-aid response, first-due responsibilities and water-rescue capabilities, and thus are more readily reached in a focused, face-to-face meeting.

### Editing Process

The collaboration between two jurisdictions to resolve PSAP boundaries will take multiple sessions. GIS staff are not responsible for redefining PSAP boundaries beyond the jurisdictional boundary. However, the PSAP boundary between two jurisdictions can, and should, be resolved to the approximate jurisdictional boundary before involving the PSAP leadership.

<sup>16</sup> [http://earth-info.nga.mil/GandG/wgs84/web\\_mercator/index.html](http://earth-info.nga.mil/GandG/wgs84/web_mercator/index.html)

<sup>17</sup> Editing of data requires an Esri account linked to the MD iMAP portal. At the request of the ECC, these data have been restricted to government use.

Once a source dataset has been selected, GIS staff must insert the NG9-1-1-required fields into the attribute table. The table below is the NENA NG9-1-1 GIS Data Model schema for PSAP boundaries.

Table 2: NENA GIS Schema: PSAP Boundary

Descriptive Name	Field Name	M/C/O	Type	Field Width
Discrepancy Agency ID	DiscrpAgID	M	P	75
Date Updated	DateUpdate	M	D	-
Effective Date	Effective	O	D	-
Expiration Date	Expire	O	D	-
Emergency Service Boundary NENA Globally Unique ID	ES_NGUID	M	P	254
State	State	M	P	2
Agency ID	Agency_ID	M	P	100
Service URI	ServiceURI	M	U	254
Service URN	ServiceURN	M	P	50
Service Number	ServiceNum	O	P	15
Agency vCard URI	AVcard_URI	M	U	254
Display Name	DsplayName	M	P	60

### PSAP-to-Jurisdiction Boundary Resolution

GIS staff can begin the boundary resolution process by removing any overlaps or gaps in the boundary files between the two jurisdictions. If the source data used is void of any such errors, this process simply will require GIS staff to validate the dataset's quality. Boundary files may have been created decades ago, and therefore may require updating along stream beds, road centerlines, and other landmarks used in the original creation that have changed over time.

#### Property Lines

The jurisdictional boundaries may bisect property or building footprints. GIS staff, in collaboration with PSAP leadership, should decide before the initial editing session whether the PSAP boundary will be edited to follow property lines or adjusted to avoid bisecting buildings or campuses with a single point of ingress. When drawing PSAP boundaries, consideration should be given to:

- Keeping entire properties within one PSAP boundary
- For multi-dwelling unit properties or campuses, setting PSAP boundaries between buildings
- Factoring in driveway ingress to the property
- For boundaries along edge of pavement between jurisdictions, shifting the PSAP boundary to the roadway center to avoid conflicts between address points and centerline address matching.

## Water Features

Maryland's jurisdictional boundaries were drawn around hydrographic features starting in 1638 with the boundary between Saint Mary's County and Virginia established at the Potomac River. Because water will redefine the landscape dramatically over several centuries, jurisdictions sharing boundaries based on water features must revisit the landscape through the use of orthoimagery provided by the State.<sup>18</sup>

As many of the jurisdictional water boundaries are based on the high-water mark, which changes with the tides and seasons, the high-water mark generally will not serve as a good PSAP boundary. When drawing PSAP boundaries along waterways, consideration should be given to:

- Navigability of the waterway
- Access points onto the water (e.g., boat ramps)
- Docks and marinas
- Presence of islands within the waterway and access to islands

## PSAP-to-PSAP Boundary Resolution

In the 9-1-1-call-to-response process, every second counts toward realizing a positive outcome. The end goal for adjusting the PSAP boundary away from the jurisdiction boundary is to minimize call transfers, which delay the delivery of emergency services.

Once the individual jurisdictions' PSAP boundary files are created and resolved between the two jurisdictions, the process now relies on the expertise of the PSAP directors in each jurisdiction to adjust the boundaries based on historical call-processing challenges. This is best accomplished in person, with each jurisdiction's GIS expert editing the data. To expedite the process, a group of jurisdictions sharing common boundaries can meet en masse to resolve multiple boundaries simultaneously.

## Boundary Maintenance

Boundaries should be revisited when development occurs along the boundaries. As with all border geometry, every time edits to a PSAP boundary are necessary, these edits must be coordinated with the neighboring jurisdiction(s). Likewise, edits to the PSAP boundary file must be made available to the State and to all Emergency Services Internet Protocol Network (ESInet) and spatial interface (SI) providers in the state.

Maintenance of the NG9-1-1 geospatial data is imperative to the life-safety mission. GIS must maintain the datasets supporting NGCS and also must coordinate any edits with neighboring jurisdictions and the State immediately.

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<sup>18</sup> <https://imap.maryland.gov/Pages/imagery.aspx> : <http://imagery.geodata.md.gov:8080/ExpressZip>