City of Manassas, VA., Geographic Information System Use Case

The data produced by a Geographic Information System (GIS) is an essential component of Next Generation 911 (NG911) and enhancing public safety communications.[2] In addition to other datasets, GIS accesses, uses, and analyzes spatial data from navigation systems such as

> A **Geographic Information System (GIS)** is defined as "a computer system that analyzes and displays geographically referenced information."[1]

Global Positioning System (GPS) and Global Navigation Satellite System (GNSS).[3] GIS capabilities[4] are necessary for NG911 systems to route calls to the most appropriate emergency communications center (ECC)/public safety answering point (PSAP) based on the caller's location.[5] Accurate geographic data is essential for dispatch of emergency responders, and GIS capabilities continue to evolve (e.g., z-axis, 3D, enhanced user interface). GIS capabilities enable mapping applications to use location information from cellular towers, network switches, and other supplemental location data sources.[6] This allows the ECC/PSAP to receive more accurate geographic information for the call, and it also allows the ECC/PSAP to share critical geographic information (e.g., mountainous terrain, waterways) with the appropriate agency to improve situational awareness.

This use case study documents lessons learned from the City of Manassas' (VA), implementation of a GIS as part of their transition to NG911. The Cybersecurity and Infrastructure Security Agency (CISA), SAFECOM, National Council of Statewide Interoperability Coordinators (NCSWIC), and City of Manassas worked collaboratively to develop the *GIS Lifecycle Best Practices Guide for NG911*. Manassas volunteered to provide more detail on their experience to help others implement GIS capabilities for NG911. The document highlights the City of Manassas' process of implementing a GIS system. Paired with the *GIS Lifecycle Best Practices Guide for NG911*, it provides users with helpful tips for navigating the GIS Lifecycle, including planning, governance, funding, and security considerations.[7]

Prepare – Inform organization leadership, announce to staff, and secure the decision

The first phase of the GIS lifecycle is preparation. During this phase, organizations assess the need to replace, upgrade, maintain, share, or acquire a new GIS system. It is important that organizations understand how their technologies interconnect with other coordinating entities, including GIS

---

[1] United States Geological Survey (USGS), "What is a geographic information system (GIS)?" last accessed March 30, 2020.
[2] The SAFECOM/NCSWIC Cyber Risks to NG911 document discusses cyber risks to NG911 systems and provides resources and best practices for securing NG911 systems.
[3] Humboldt State University, "GSP330: Mobile Mapping & GIS Terminology," last accessed August 25, 2020.
[4] In an NG911 system, providing location requires coordination among multiple elements. For example, a Location Validation Function (LVF) may validate the IP endpoint of the calling device against a local 911 authority's provisioned GIS data. The locally provisioned GIS data is also used to route the 911 call with the Emergency Call Routing Function (ECRF) or a similar function. A Location Information Server (LIS) is necessary to provide the location of the endpoint to route 911 calls if using the i3 standard (NENA Standard for NG911 GIS Data Model).
[5] These centers include ECCs, PSAPs, 911 centers, public safety communications centers, emergency operations centers, and other public service communications centers.
[6] For more information on the relationship between GIS and NG911, reference the NENA Standard for NG911 GIS Data Model and NENA Standards for the Provisioning and Maintenance of GIS data to ECRF and LVFs.
[7] CISA, GIS Lifecycle Best Practices Guide for NG911, last accessed December 22, 2020.

systems. The City of Manassas, took the necessary steps to assess their GIS capabilities to prepare for NG911.

Manassas is an independent city located in Northern Virginia with a population of approximately 41,457.[8] The City of Manassas is geographically surrounded by Prince William County and the City of Manassas Park. The Manassas 911 system is a blend of primary and secondary emergency communications centers (ECCs)/public safety answering points (PSAPs).[9]

Helpful Hint: Raise awareness about GIS requirements for NG911

In 2015, Manassas began collaborating with Fairfax, VA., to prepare for the transition to NG911. Fairfax engaged with neighboring jurisdictions to raise awareness about NG911 and share their plans for transitioning to NG911. Prior to 2015, Manassas had a robust GIS system in place; however, the data needed extensive review to be ready for NG911. To prepare for the transition to NG911, the City of Manassas Information Technology (IT) and GIS group engaged with other city senior leadership to raise awareness about the critical role that GIS plays in the transition to NG911. Manassas was able to enhance local understanding of the critical role that GIS plays in NG911 and the importance of updating GIS capabilities to meet requirements for NG911.

Plan – Create a project plan that aligns to all guiding documents

The second phase of the GIS lifecycle is planning. This phase involves collaborating with partners to develop a GIS implementation plan. It is recommended that organizations align the activities to overarching organizational mission(s) and ensure that they are compliant with the organization's existing rules, regulations, and guidance. Establishing an implementation plan helps ensure a coordinated approach to implementing GIS capabilities to avoid deployment of disparate systems.

Helpful Hints: Form a project team; define and document GIS system requirements from all departments and jurisdictions served by the ECC/PSAP

The Virginia 911 Services Board adopted the Virginia NG911 Deployment Plan in January 2018 to ensure a coordinated approach to implementing NG911 capabilities across the Commonwealth of Virginia. To assist localities, the Virginia Information Technologies Agency (VITA) prepared a NG911 migration proposal for each locality to "provide information about the Emergency Services Internet Protocol Network (ESInet) solution, prerequisite work needed within the PSAP, and the expected costs and funding provided by the 911 Services Board."[10]

Initially, Manassas was not included in the primary agreement because they were not considered a primary emergency communications center (ECC)/public safety answering point (PSAP), as they were not directly answering wireless calls. Additionally, reporting for cell phone towers was not included in the NG911 solution. Given their proximity to Prince William County, this information was necessary to determine which calls needed to go to Manassas. Manassas engaged with VITA to update the proposal to ensure that the NG911 solution addressed their needs.

---

[8] ManassasVA.Gov, Key Demographics: December 2019 Update, last accessed December 29, 2020.
[9] In a Primary PSAP, 911 calls are routed directly from the 911 Control Office. In a Secondary PSAP, 911 calls are transferred from a Primary PSAP. NENA Master Glossary of 911 Terminology, last accessed January 28, 2021.
[10] Virginia Department of Emergency Management, Commonwealth of Virginia Next Generation 911 City of Manassas PSAP/GIS Specific NG911 Migration Proposal, last accessed January 3, 2021.

Helpful Hint: Establish a strong and transparent governance structure

Establishing a strong and transparent governance structure is critical to implementing and maintaining a GIS system. Gathering GIS data, including road centerlines, address points, provisioning boundaries, service boundaries, and ECC/PSAP boundaries, requires close collaboration across state, local, tribal, and territorial stakeholders. Formalized governance structures establish common goals and provide a foundation for collaboration, planning, and operations among stakeholders.[11]

Manassas participates in a strong governance structure inclusive of state, regional, and local partners. Manassas collaborates closely with neighboring jurisdictions, such as Prince William County and Manassas Park and is considering establishment of a formal agreement to ensure continuity. At the regional level, Manassas is a member of the Northern Virginia GIS Managers group. The group established a formal agreement to outline their mission and purpose. It provides members with an opportunity to collaborate and address any challenges related to GIS throughout the region. Manassas is also a member of the Metropolitan Washington Council of Governments (COG). Through COG, IT managers established memorandums of understanding (MOUs) outlining how members will collaborate and share data for NG911.[12]

Procure – Procure GIS resources

The third phase of the GIS lifecycle is procurement. During this phase, organizations collaborate with partners to identify GIS system requirements. Organizations may develop a request for proposal (RFP) to select a vendor for providing GIS capabilities. Alternatively, organizations may look to procure GIS capabilities through a state GIS office (if applicable) or by establishing intergovernmental agreements with a major city to expand their current GIS services.

Helpful Hint: Assess staffing needs

In 2017, Fairfax County awarded a contract for their ESInet solution.[13] Localities had the option to select the Fairfax contract or choose another provider. Manassas reviewed the contract to ensure it met their needs and signed on to the Fairfax agreement in 2019.

In order to prepare for upgrading their GIS capabilities for NG911, Manassas took into consideration staffing needs. Manassas hired an additional staff member to support NG911 transition efforts. The staff member updated and validated Manassas's GIS datasets. Over the past five years, Manassas made significant progress to ensure they met the necessary requirements for NG911. Manassas staff continue regular maintenance to keep their GIS system up-to-date with NG911 connectivity and data models as a primary focus.

Implement – Incorporate data management strategies that establish provisioning boundaries

The fourth phase of the GIS lifecycle is implementation. During this phase, the ECC/PSAP, GIS department, vendors, and all other partners continue to work together closely to execute the

---

[11] CISA, National Emergency Communications Plan (NECP), last accessed February 9, 2020.
[12] Metropolitan Washington Council of Governments, last accessed February 10, 2021.
[13] Fairfax County, Virginia, Contract Details - Contract Register - Fairfax County, Virginia, last accessed February 10, 2021.

implementation plan. The implementation process of an organization varies based on the GIS paradigm, data management principles, available technology, and organizational setting.

Helpful Hint: Conduct a comprehensive review of GIS data

Accurate GIS data is essential for NG911 systems to route calls to the most appropriate ECC/PSAP based on the caller's location. In order to prepare for NG911, Manassas participated in Fairfax-led contracts with vendors to review GIS data. These reviews included numerous checks on centerline, address points, and boundaries as well as reviewing the Automatic Location Identification (ALI) and Master Street Address Guide (MSAG) databases. Manassas conducted extensive reviews of their GIS dataset and spent approximately 18 months resolving any errors or inconsistencies. To support jurisdictions in the transition to NG911, VITA developed a NG911 GIS Data Report Card toolkit to allow jurisdictions to independently perform data validation checks.[14] Manassas used the toolkit to help review the status of their GIS data compared to ALI and MSAG data. The toolkit provided the ability to repeatedly check the data to see incremental improvement when correcting errors.

Helpful Hint: Collaborate with neighboring jurisdictions to establish provisional boundaries

As Manassas reviewed their GIS data, they engaged closely with neighboring jurisdictions to address geographical challenges, such as bridges and roadways that cross multiple jurisdictions. To ensure there were no gaps in the data, Manassas collaborated with other jurisdictions to establish provisional boundaries and made assignments of jurisdictions responsible for uploading the data to the ESInet. Manassas maintains all the GIS data that falls within their provisioning boundary and provides a copy to the state. The data is uploaded into the Emergency Call Routing Function (ECRF) for validation with neighboring jurisdictions.[15] They assign unique identification fields to all centerline segments and address points to ensure address points are not repeated. Manassas manually communicates updates to neighboring jurisdictions, as needed (e.g., overlapping roads).

The Commonwealth of Virginia developed a phased approach to transition all ECCs/PSAPs to NG911. Fairfax County announced the launch of NG911 services in June 2020.[16] Manassas was part of Phase 1 of the NG911 deployment schedule. In October 2021, Manassas successfully completed the transition to the NG911 system using geospatial call routing.[17]

Special Thanks

CISA thanks the City of Manassas for its contributions to this use case and dedication to resilient, operable, and interoperable public safety communications.

For more information on this and other NG911 initiatives, contact ng911wg@cisa.dhs.gov or visit cisa.gov/safecom/next-generation-911.

---

[14] Virginia Geographic Information Network, Virginia GIS Data Report Card Tools for NG911 Preparation, last accessed July 8, 2021.

[15] The ECRF is a functional element in an NGCS (NG911 Core Services) which is a LoST protocol server where location information (either civic address or geo-coordinates) and a Service URN serve as input to a mapping function that returns a URI used to route an emergency call toward the appropriate PSAP for the caller's location or towards a responder agency. NENA Master Glossary of 911 Terminology, last accessed April 16, 2021.

[16] Fairfax County Emergency Information, Fairfax County Launches Next Generation 911 Service, last accessed February 24, 2021.

[17] Virginia NG911 Dashboard, last accessed February 10, 2021.