The California Statewide Next Generation 911 Geographic Information System

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

The data produced by a Geographic Information System (GIS)[1] is an essential component of Next Generation 911 (NG911) and for enhancing public safety communications. GIS accesses, uses, and analyzes spatial data from navigation systems such as Global Positioning System (GPS) and Global Navigation Satellite System (GNSS).[2] GIS capabilities[3] 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.[4] 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.[5] 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 State of California's implementation of a statewide GIS as part of their transition to NG911. The Department of Homeland Security (DHS) Cybersecurity and Infrastructure Security Agency (CISA), SAFECOM, National Council of Statewide Interoperability Coordinators (NCSWIC), and the State of California worked collaboratively to develop the *GIS Lifecycle Best Practices Guide for NG911*. California volunteered to provide more detail on their experience to help others implement GIS capabilities for NG911. This document highlights California's process of implementing a statewide 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.[6]

Prepare – Assess the need to replace, upgrade, maintain, share, dispose of, or acquire a new GIS system

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. When assessing capabilities and integrating new technologies, it is important to look across the Emergency Communications.

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[1] United States Geological Survey (USGS), "What is a geographic information system (GIS)?" last accessed March 30, 2020.
[2] Humboldt State University, "GSP330: Mobile Mapping & GIS Terminology," last accessed August 25, 2020.
[3] In an NG911 system, providing location requires coordination between 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 NG9-1-1 GIS Data Model).
[4] These centers include ECCs, PSAPs, 911 centers, public safety communications centers, emergency operations centers, and other public service communications centers.
[5] For more information on the relationship between GIS and NG911, reference the NENA Standard for NG9-1-1 GIS Data Model and NENA Standards for the Provisioning and Maintenance of GIS data to ECRF and LVFs.
[6] CISA, GIS Lifecycle Best Practices Guide for NG911, last accessed December 22, 2020.

Ecosystem as defined in the National Emergency Communications Plan to ensure capabilities are operable and interoperable across agencies and jurisdictions.[7]

HELPFUL HINT: Conduct a cost-benefit analysis on maintaining selective routers

Recognizing the need to update their 911 system, the California 911 Branch developed an NG911 roadmap in 2010 to begin transitioning their analog 911 systems to digital and Internet Protocol (IP)-based systems, known as NG911. California has made significant progress since then to transition to an NG911 system.[8] The California Office of Emergency Services (Cal OES) began the process by conducting a cost-benefit analysis of their current system. Cal OES determined that the cost of maintaining selective routers and Automatic Number Identification (ANI) and Automatic Location Identification (ALI) databases outweighed the benefits of receiving the data. Further, transitioning to a NG911 system would improve the accuracy and resiliency of 911 services. Cal OES developed an NG911 plan that would not rely on any legacy 911 component. The NG911 system would include a Location Database (LDB) and an Emergency Call Routing Function (ECRF) that contained the geospatial data needed to route 911 calls.

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 missions 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.

In preparation for transitioning to NG911 and implementing a statewide GIS system, California engaged with other state and local partners who had implemented GIS systems and were farther along in the NG911 transition process. Early engagement allowed them to learn about different models, requirements, and best practices. Cal OES also researched relevant federal, state, and local statutes and regulations, as well as industry standards. This allowed them to develop a plan that met the state's needs while aligning with applicable laws, regulations, and nationally recognized standards.

The Cal OES 911 Emergency Communications Branch (CA 911 Branch) developed a NG911 Transition Plan that outlined a phased approached for implementing NG911 capabilities across all ECCs/PSAPs in the state.[9] Cal OES also developed a NG911 GIS Plan white paper to help state and local agencies develop GIS plans in support of NG911. In California, 438 centers support more than 28 million calls over a diverse geographic landscape. During the planning process, Cal OES engaged with ECCs/PSAPs to ensure plans were inclusive of their needs.

HELPFUL HINT: Develop an implementation strategy or plan that outlines roles and responsibilities

The Cal OES NG911 implementation plan clearly defines roles and responsibilities for the state, ECCs/PSAPs, and NG911 vendors. Cal OES is responsible for overseeing the statewide network,

[7] DHS, National Emergency Communications Plan, last modified July 13, 2020.
[8] Cal OES, "Next Generation 9-1-1 (NG9-1-1) in California," last accessed August 3, 2020.
[9] Cal OES, "NG911 Transition Plans," last accessed August 6, 2020.

ensuring compliance with current statutes, regulations, and standards, and facilitating collaboration among ECCs/PSAPs and vendors. Local entities play an integral role in providing GIS data that informs the NG911 GIS dataset. Cal OES is responsible for validating and updating the state dataset.

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, 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.[10]

Cal OES implemented a strong governance structure that was inclusive of all partners, and developed formalized structures to facilitate the implementation of a statewide GIS system for NG911. Cal OES designated four regional NG911 Service Providers and one prime NG911 Service Provider. To provide operational input to the system, Cal OES established Regional Task Forces to ensure the efforts for each regional NG911 Service Provider aligned with the operational needs of the ECC/PSAP. Cal OES also leveraged the established 911 Advisory Board, County Coordinators, Regional Coordinators, Project Management Teams, a GIS Task Force, and a Long Range Planning Committee (LRPC).[11]

California engaged with ECC/PSAP stakeholders across the 438 centers to ensure their needs were met. Through their engagement, Cal OES addressed liability concerns about sharing data and helped them understand the process. Figure 1 illustrates the Cal OES NG911 governance structure.

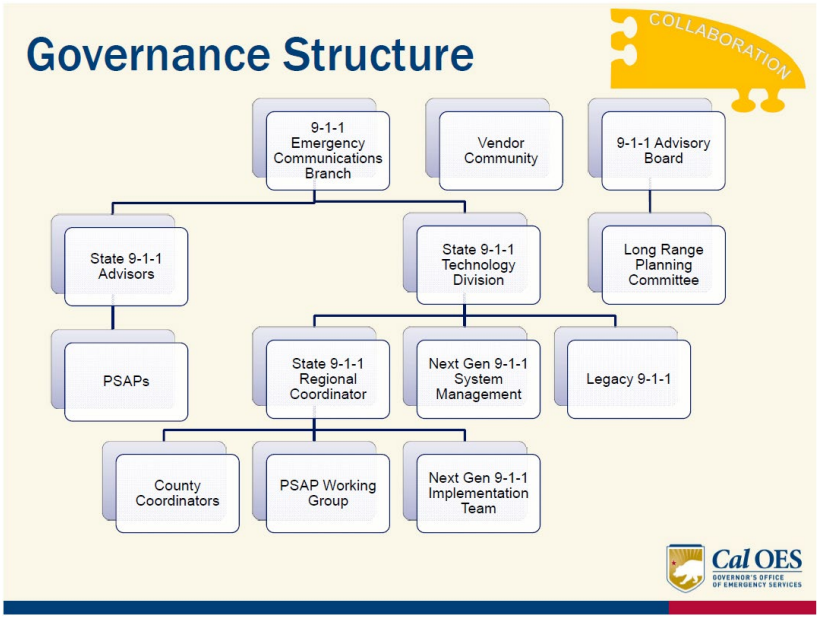

Figure 1. Cal OES NG911 Governance Structure[12]

[10] Cybersecurity and Infrastructure Security Agency (CISA), National Emergency Communications Plan (NECP), last accessed August 9, 2020.
[11] Cal OES, "NG911 Transition Plans," last accessed August 6, 2020.
[12] California 911 Emergency Communications Branch, Next Generation 9-1-1 Information & Collaboration Presentation, last accessed August 14, 2020.

Procure – Apply strategic funding method(s) that align to the GIS lifecycle

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: Collaborate with partners to identify GIS system requirements

California has a large population of more than 39 million, spanning a diverse geographic region that includes mountains, waterways, and deserts. Cal OES engaged with a broad range of state and local stakeholders to identify GIS system requirements. Cal OES incorporated these requirements into their request for proposal (RFP) process to select a prime NG911 Service Provider and a GIS vendor. Incorporating state and local requirements into their RFP process helped ensure their GIS solution met the needs of all stakeholders– from rural areas to large urban cities.

HELPFUL HINT: Identify funding mechanisms to support the necessary transition, implementation, operations and maintenance, and/or sustainment of investment(s)

To account for the implementation and sustainment of their NG911 system, Cal OES established short-term and long-term funding models.[13] Cal OES received funding through the state budget. Additionally, in 2019, the California Emergency Telephone Users Surcharge Act updated the State Emergency Telephone Number Account (SETNA) funding model to provide revenue for NG911 implementation.[14] Cal OES selected to reimburse cities and counties for costs associated with collecting and maintaining GIS data needed to route 911 calls. When developing their funding model, Cal OES considered large cities and counties with lots of GIS data to collect and smaller jurisdictions with only a few addresses. Their funding policy clearly outlines what GIS-related expenditures are reimbursable by the state.

Support, Maintain, and Sustain – Develop procedures to ensure the maintenance of GIS, including adding new GIS data and correcting GIS files

The fifth phase of the GIS lifecycle is to support, maintain, and sustain the NG911 GIS system. Software and security upgrades and system and equipment repair are two crucial elements during this phase. GIS data maintenance is another element that warrants regular examination and validation, and processes on data deconfliction must be followed. Agencies will have to determine if cloud data storage or data center storage, both of which need to address storage needs, data accessibility, and data protection, aligns with the strategic plan.

HELPFUL HINT: Incorporate mechanisms to protect and secure systems and data

GIS systems require maintenance to ensure accurate and reliable information. GIS data sets require continual updates and validation to address new building structures and other geographic changes.

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[13] State of California 911 Operations Manual, Next Generation 911 Geographic Information System (NG911 GIS) Call Routing Funding Policy, last accessed August 14, 2020.
[14] California Legislative Information, SB-96 Emergency Telephone Users Surcharge Act, last accessed August 14, 2020.

It is important to develop a workflow process to ensure the data is validated. To keep their GIS system up-to-date, Cal OES developed the workflow process shown below in Figure 2. Cal OES maintains the state GIS data set and provides the data to local authorities to validate. When new addresses and roads are added at the local level, the workflow process is initiated to ensure the NG911 GIS dataset is updated. If the locality does not have the capabilities to update local GIS data, local agencies (ECCs/PSAPs, County Coordinators, and GIS Authorities) can validate GIS data and send updates to the state. To provide additional support, Cal OES established a dedicated 911 GIS unit to help facilitate the deployment and maintenance of GIS for NG911. Cal OES also incorporated security mechanisms to protect data, such as credentialed log-in.

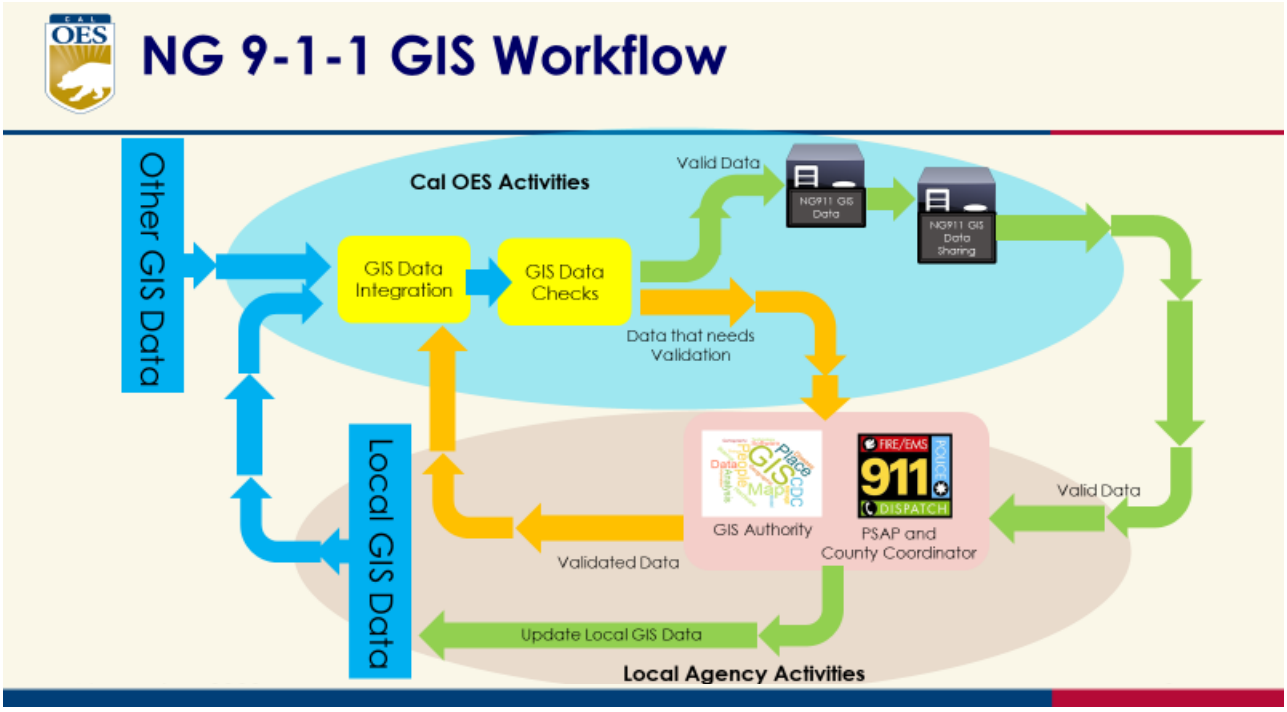

Figure 2. Cal OES NG911 GIS workflow diagram

On August 20, 2019, Cal OES announced a partnership with four contractors to assist in upgrading California's 911 system to an NG911 platform.[15] Cal OES continues to collaborate with partners to fully transition to NG911 and anticipates completing the NG911 transition in 2021.

Special Thanks

CISA thanks Cal OES 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.

[15] Cal OES News, Cal OES Announces Selection of Vendors to Modernize State 9-1-1 System, last accessed August 17, 2020.