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Why You Should Invest in an Address Point Layer

Identifying 9-1-1 Caller Location

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There is an emergency. Someone is in crisis. An emergency call for help is made. A 9-1-1 call is routed to the appropriate Public Safety Answering Point (PSAP) via a Next Generation 9-1-1 (NG9-1-1) network. The call is answered and help is dispatched to the location. Accurate location information is critical throughout the call to: determine the correct PSAP based on the location of the calling device, display the caller's location in tactical PSAP and responder mapping systems, identify the closest available units to dispatch, generate routes and driving directions, and discover additional information about the location.

For informed, quick decision making in mission critical 9-1-1 environments, accurate location information is crucial.

Accurate and reliable Geographic Information System (GIS) data is essential for accurately routing NG9-1-1 calls and responding to emergency incidents. Many different layers of GIS data are used to support NG9-1-1 call routing and emergency response today. One of the most important GIS data layers is an address point layer.

Across the nation, local authorities, regions, and states are investing their resources to build address point layers for 9-1-1. This paper answers the following question: Why should you invest in a GIS data layer to identify the location of all addressable structures within your jurisdiction?

This paper is the first in a series of papers about the benefits, development methodologies, and maintenance options for creating and maintaining an address point layer for 9-1-1.

What is an Address Point Layer?

An address point layer is a GIS data set that uses discrete coordinates to represent the geographic location of sites and structures within a jurisdiction. Address points typically contains detailed information about each location such as physical address, resident or business name, phone number, parcel information, special notes, or hyperlinks to floor plans, and structure photos. Two or even three-dimensional discrete geographic location such as a latitude/longitude coordinate is also embedded within each address point.

Address Point Layer Editing in GeoLynx Server Web DMS

Address point layers serve many purposes in the 9-1-1 world, including routing 9-1-1 calls to the correct PSAP, plotting 9-1-1 call locations on a map, and providing valuable attribute information to emergency response personnel.

Address points may be placed at the access point to a property containing a building, such as at the

intersection between a driveway and a street, or directly on top of a structure or building location.

Address Point Layers for NG9-1-1 Location Validation

Address points can be provisioned to NG9-1-1 Location Validation Function (LVF) systems. When a Location Information Server (LIS) validates civic locations using an LVF, the LVF compares street address information in the civic location being validated to address points provisioned to the LVF to determine the validity of the address. For example, a street address associated with a wireline telephone record must match an address point in the GIS database provisioned to the LVF to be considered routable and dispatchable for 9-1-1. This function replaces tabular MSAG-based location validation for 9-1-1.

Civic location information, used in NG9-1-1 systems for representing the location of devices, differs from street address information previously used in 9-1-1 since it can include sub-address elements. Sub-address elements provide refining information about a location, including building name, unit, room, seat, and place type. Sub-address information cannot be represented in a range-based tabular MSAG or address ranged road centerline layer. This is one reason that address points are better for NG9-1-1 LVF than address ranged road centerline layers.

Address Point Layers for NG9-1-1 Call Routing

Address points can be provisioned to Emergency Call Routing Function (ECRF) systems for use in routing 9-1-1 calls. When a 9-1-1 call is received at an Emergency Services Routing Proxy (ESRP) for NG9-1-1 call routing, the ESRP queries an ECRF with the location of the calling device to determine the correct PSAP to route the call to. If the calling device's location is a street address, the ECRF must have a way to convert the address into a coordinate. This coordinate is then intersected with a PSAP service boundary GIS layer to determine which PSAP to send the call to. Using an address point layer, the ECRF can match the incoming address to a single address point in the GIS, use the coordinates of this point to intersect with the PSAP service area boundary layer, and select the correct PSAP to route a call to.

Address Point Layers for NG9-1-1 Additional Data

NENA 71-001 v1 NG9-1-1 Additional Data describes several informational data structures that can be associated with a 9-1-1 call. The call data structure includes device specific information, such as make, model, and type of device, from which a 9-1-1 call is placed. The call data structure includes human information, such as emergency contacts and potentially other information such as electronic health records. The PSAP data structure includes information added by the PSAP, such as call taker notes. Finally, the location data structure can include information about a premise such as:

- Owner and tenant contact information
- Security contact information
- Building maintenance and structural engineering contacts
- Floor plans
- HVAC, alarm, and sensor status
- Automatic defibrillator locations
- Surveillance

A location data structure for a premise is referenced by a Uniform Resource Identifier/Uniform Resource Locator (URI/URL). The additional location information URI/URL is an attribute field within an address point layer provisioned to the NG9-1-1 ECRF. An authorized application, such as a PSAP mapping system, discovers the additional location data URI/URL by querying an ECRF provisioned with an address point layer containing the additional location data URI/URL attribute field. Therefore, address point layers are critical for discovering NENA 71-001 NG9-1-1 Additional Data associated with a location.

Address Point Layers for PSAP and Responder Mapping Systems

Address points are useful in PSAP and emergency responder tactical mapping applications. They can be the primary mechanism for displaying the location of a 9-1-1 call from a fixed location device on a map display. This has been a common use for address point layers for many years, even before NG9-1-1. However NG9-1-1 adds additional considerations. Since address points may be used for core NG9-1-1 functions of validating locations and routing 9-1-1 calls, it is important for the same address point layer that is provisioned to ECRF/LVF systems (including daily adds, moves, changes, and deletes to this point layer) be provisioned to PSAP and responder tactical mapping systems.

In addition, sub-address elements of building name, unit, room, seat, and place type defined in the civic location format used in NG9-1-1 are useful in PSAP and responder tactical mapping applications. Address points can also be enhanced with vital details, such as the number of buildings and apartments included in a complex and other location specific information useful for emergency responders.

Address point layers are especially beneficial for mapping locations in non-conventional, multi-unit structures, where an existing premise has been divided into several units. In these cases, existing house number prefixes and suffixes can be more accurately mapped. For example: house numbers such as 103 ½, 103A, etc., can be accommodated. Similar benefits exist when mapping campus environments using address points.

Other Uses for Address Point Layers

Address point layers are commonly used in public safety and law enforcement applications beyond the 9-1-1 PSAP and emergency responder environment. A common scenario is to create an address point layer for use in an Emergency Notification System (ENS). In this case, address points include contact information such as telephone numbers, e-mail addresses, and mobile phone, and SMS addresses. ENS operators can use spatial selection tools in a GIS such as radius searches, hand drawn search areas, shared markups and user drawings, and hazardous materials protective action zones to select contacts for notification on the map. Address points enable geographic contact selection for notification during emergencies and disasters.

In addition, address point layers can be shared across other departments within a city, county, region, or statewide GIS enterprise, such as the

assessor's office, health and human services, planning and zoning, and utilities.

Identifying groups of users sharing requirements for locally authoritative address point layers outside of 9-1-1 can foster cost sharing opportunities within state and local government enterprises.

Road Centerline Layers: An Alternative to Address Point Layers

Address points are used to represent discrete two-dimensional coordinate locations in a GIS database and to describe informational attributes about that location. However, it is possible to represent site/structure information in a GIS using non-point based feature types. Address locations can also be described via an address ranged road centerline layer.

Road centerline layers (RCL) have inherent limitations for locating addresses. Road centerline layers consist of line features where each line is attributed with addressing information such as low and high address ranges and street names. The location of a street address is determined by finding the correct line segment based on the house number and street name of the address, and the corresponding line segment with the correct street name and range of house numbers. The address location is computed as a percentage along the street segment based on the house number of the address and address ranges on the segment, offsetting a fixed distance to the left or right side of the street based on even/odd parity of the house number, and cushioning a fixed distance from either end of the street segment.

A limitation of RCLs is that address locations are estimated and not precisely placed on a map. Therefore, map positioning can be much less accurate than address points, which can be digitized precisely into the map, such as exactly at a property ingress or on top of a site/structure. In addition, unlike address point layers, RCLs do not support house number suffixes or sub address elements, further diminishing the precision of RCLs when compared to address point layers.

Similar to tabular 9-1-1 MSAGs, RCLs also provide a range of all theoretically possible addresses along a road segment. If an RCL is used in an LVF for validating 9-1-1 address locations, there is potential to validate an address with a house number and street name that fits an RCL segment, but where a building does not actually exist at the specified house number. This could result from a data entry error when provisioning a new telephone service. With an RCL, the location validates and 9-1-1 calls route properly, but when dispatching emergency personnel to the scene, they might find that the address does not physically exist in the field.

Site Structure Polygon Layers: An Alternative to Address Point Layers

In addition to address points or road centerline segments, locations may be described by sub-parcel or building footprint polygons. Building footprint polygons attributed with address and sub-address information can provide more detailed information than address points. Commonly, site/structure polygons are captured by heads up digitizing from aerial imagery or

automated feature extraction from high resolution aerial imagery, or Light Detection and Ranging (LIDAR).

NG9-1-1 supports site/structure polygons for locating addresses. NENA's long-range vision for GIS in 9-1-1 includes highly-accurate two-dimensional, and even three-dimensional, site/structure representations. Site/structure polygons would provide a viable alternative to address points were it not for the cost of GIS data development and ongoing daily maintenance, which can be prohibitive for this class of data. It is possible that site/structure polygon layers may become more affordable in the future with declining cost of aerial and ground based LIDAR acquisition, decreased cost and increased availability of specialized processing software, and potential future Federal Aviation Administration (FAA) integration of Unmanned Aircraft Systems (UAS) into the National Airspace System (NAS) for purposes of capturing remotely sensed data.

Risks Associated with Address Point Layers

Address point layers presently have the most advantages and least disadvantages over other feature types for representing civic locations in a GIS for NG9-1-1. This is driving significant efforts across the United States to build regional and statewide address point layers for public safety. However, it is important to consider risks associated with address point layers for 9-1-1, so that such risks can be mitigated as local authorities, regions, and states move to address point layers as the primary civic location GIS data set for 9-1-1.

One risk of address point layer development and ongoing maintenance is increased cost compared to RCL development and management. A RCL segment can support a new address for a new construction without modification to the GIS. If the new house number falls within a previously created address range on an existing RCL segment, no GIS change is required. In contrast, if using an address point layer to represent civic locations, then the address point layer must be edited and a new GIS record for the new point must be inserted into the GIS database. Because the GIS database must be edited more frequently for address point layers than for RCLs, ongoing GIS data management and maintenance costs may be higher.

Requiring address point layer edits for every new or changed 9-1-1 address also produces a corresponding ECRF and LVF risk. A RCL might require no GIS change to be provisioned to ECRF/LVF, whereas an address point layer might require a GIS edit that must then be published to an ECRF/LVF. The time that it takes to accomplish the edit and to provision the update to the ECRF/LVF creates risk. A 9-1-1 call could be made from the new location before the GIS, provisioning, and ECRF/LVF update process has occurred.

Site/structure polygons have similar risks as address points and perhaps greater risk due to increased complexity of the GIS data.

RCLs may provide less risk during data management, but overall create more risk because they are less accurate, do not support sub-address information or NG9-1-1 additional

location data URI/URL attributes, and allow theoretical addresses that do not actually exist in the field to be present in the 9-1-1 GIS.

As a result, address point layers remain the best and most viable option. Data management risks should be managed through properly designed and developed regional and statewide GIS data management systems. For example, web-based GIS portals and well-designed enterprise GIS systems can streamline address point GIS change requests, data editing and administration, quality control and assurance, performance measurements, unified provisioning to ECRF/LVF and PSAP mapping systems, and continual reporting, alarming, and feedback mechanisms.

Getting Started

To begin, inventory the GIS data currently being used in your dispatch mapping applications. Determine if there is an address point data file included in them, and if so, how accurate and current the data is. Also, determine if your agency has a maintenance program in place to update the data layer and how much additional location information is already included in the data layer. If your agency does not have an existing data layer, determine if your dispatch mapping and Computer Aided Dispatch (CAD) applications can accommodate the use of an address point file when plotting emergency calls.

Check to see if regional or statewide initiatives for building and managing address point layers for other uses already exist; for example, statewide address point development projects funded by the National Telecommunications and Information Administration (NTIA) as part of the broadband mapping and planning initiative.

Conclusions

Accelerating numbers of local, regional, and statewide address point development projects are being fueled by NG9-1-1 today. Many 9-1-1 authorities are evaluating GIS in advance of, or coincident with, NG9-1-1 Emergency Services IP Network (ESInet) procurements. Address point layers provide value to PSAPs, emergency responders, and other users beyond the core NG9-1-1 functional elements of ECRF/LVF. Therefore, there is benefit to building address point layers and corresponding data management systems in advance of NG9-1-1 implementations.

The **benefits** of an accurate and up-to-date GIS address point layer are many. In summary, an address point layer:

- Provides the core location validation database for NG9-1-1 and can validate sub-address elements of building name, unit, room, seat, and place type, unlike tabular 9-1-1 MSAGs.
- Provides the core emergency call routing GIS database for devices referenced by civic address locations, such as wireline telephones and other fixed location devices.
- Provides the critical linkage between caller location and NG9-1-1 additional data associated with a location for discovering additional premise, owner, and tenant data using an ECRF.
- Provides more accurate and precise location mapping for PSAP and emergency responder tactical applications.
- Supports other mission critical uses within the public safety enterprise, such

as ENS, and can be used by other departments beyond 9-1-1 and public safety.
- Maps precise site/structure locations and sub-address information and maps only real-world locations, not just ranges of possible addresses.
- Provides a more affordable option than site/structure building footprint polygons.

State, regional, and local 9-1-1 authorities should evaluate which address point databases are currently available for usability in planned NG9-1-1 implementations. NG9-1-1 plans and vision statements should be evaluated with respect to address point GIS data acquisition, aggregation, coalescing of address point GIS data from multiple sources, ongoing GIS address point data management workflows, and NG9-1-1 core ECRF/LVF and PSAP mapping system provisioning.

Next up in the GeoComm Address Point White Paper Series

This is the first paper in a series of papers exploring various considerations aimed at developing and maintaining an address point layer for 9-1-1.

About Geo-Comm, Inc.

Geo-Comm, Inc (GeoComm) is a proven provider of end-to-end consulting and GIS systems tailored to meet the needs of any public safety agency. GeoComm is the leading innovator of NG9-1-1 GIS services and software, including NG9-1-1 GIS data assessment and development, software to maintain, manage, and provision GIS data, the ECRF/LVF elements of the ESInet, and tactical mapping for the PSAP.

GeoComm's GeoLynx Family of Products provides the tools necessary to speed and enhance emergency response. These tools reduce response times, improve data accuracy and quality, accelerate communications, and provide mission critical GIS-based decision support.

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