State of Arizona 9-1-1

GIS Standards

Updates are listed in **RED**.

Arizona 9-1-1 GIS Standards

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Document Description and Purpose

This document contains the State of Arizona's 9-1-1 Geographic Information System (GIS) standards. These standards were developed for two reasons; 1) to ensure a high level of accuracy for State funded mapped ALI systems and 2) to assist each 9-1-1 system with their GIS/mapped ALI endeavors.

The State of Arizona Phase I & II Wireless Implementation Plan states:

> *If a county is ready to receive Phase II service – i.e., they have developed an MSAG and valid GIS file and there are processes in place to keep it current – then Phase II will be deployed if requested be the county (funds permitting).*

The purpose of this document is to define a "valid GIS file". This document also contains GIS requirements for 9-1-1 systems that plan to upgrade to mapped ALI (i.e. mapping on wire line and wireless calls).

NOTE: 9-1-1 Systems that were installed prior to these standards being put in place must still adhere to the GIS requirements listed below. Their GIS data will be evaluated and deadlines will be set for making modifications.

These standards have been developed during a period when no national standards are in place. Should national standards be developed and approved, Arizona's 9-1-1 Office will evaluate those standards and make modifications to AZ's standards, as deemed appropriate.

GIS Data Requirements

In order to have an effective, fully operational Mapped ALI/Dispatch mapping software program, three GIS data layers are required for use with the mapped ALI software. These data layers are the street centerlines, Emergency Service Number (ESN)/Emergency Service Zone (ESZ) boundaries, and community boundaries. There are also certain data layer attributes that are required for these data layers to be effective. The required data attributes for these GIS data layers are listed below. In addition, the *NENA GIS Data Model* can be found in APPENDIX A. This model may be helpful to agencies that are modifying or creating new GIS layers for use in 9-1-1 and/or public safety.

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Required GIS Data Layers

Mapped ALI software requires three GIS data layers to function properly. The three layers are street centerlines, ESN/ESZ boundaries, and community boundaries. The specific field requirements for these layers are outlined below.

Street Centerline
1. Must include the following fields (see APPENDIX A for field names, types and lengths required for data sharing):

   a. Prefix Directional
   b. Street Name
   c. Street Type
   d. Suffix Directional
   e. Left From Address
   f. Left To Address
   g. Right From Address
   h. Right To Address
   i. Left Zone (MSAG Community or ESN)
   j. Right Zone (MSAG Community or ESN)
   k. One way
   l. Alias Street Name
   m. Source of Update
   n. Date of Update

ESN/ESZ Boundaries
1. Must include the following fields (see APPENDIX B for field names, types, and lengths):
   a. ESN
   b. PSAP Name
   c. Fire
   d. Medical
   e. Law

MSAG Community Boundaries
1. Must include the following fields (see APPENDIX B for field names, types, and lengths):

a. MSAG Community Name

Other Useful GIS Layers (not required*)

Below is a list of supporting map layers that are beneficial for 9-1-1 mapping.

Address Points: point locations of all addressable sites/structures
Parcel Boundaries: map layer of property parcel boundaries
Hydrology: lines and polygons depicting water ways
Railroads: lines depicting railroads
Fire Hydrants: point locations of fire hydrants
Mile Markers: point locations of mile markers
Township/Range Boundaries: map layer of township and range boundaries
Emergency Buildings: point locations of emergency buildings
Cell Towers: point locations of cell towers
Cell Coverages: pie-shaped polygons depicting cell coverage areas
Common Places: point locations of well known structures and/or areas
Parks/Cemeteries: polygons representing park and cemetery locations
Response Boundaries: polygons representing police beats and fire districts
Aerial Imagery: images of the earth collected from the sky or space

* Please note that the Arizona 9-1-1 Office does not fund any these of these map layers. In other words, each 9-1-1 System is responsible for acquiring, validating, maintaining, and storing these map data.

Metadata

Every 9-1-1 System will eventually exchange GIS data with surrounding 9-1-1 Systems. For this reason, it is necessary for agencies to maintain metadata for each GIS data layer used in the mapped ALI systems.

Metadata, as defined by ESRI:

Information about the content, quality, condition, and other characteristics of data. Metadata for geographic data may document its subject matter; how, when, where, and by whom the data was collected; accuracy of the data; availability and distribution information; its

> *projection, scale, resolution, and accuracy; and its reliability with regard to some standard.*

A sample GIS metadata form can be found in APPENDIX C. The State of Arizona requires that the following information be included in your GIS metadata:

> Publication Data (Author and Date): see metadata under *Identification Information*
> Map Projection: see metadata under *Spatial Reference Information*
> Spatial Accuracy: see metadata under *Data Quality Information*
> Contact Information: see metadata under *Identification Information*

***Please contact the State's 9-1-1 GIS Coordinator with any metadata related questions.

Special Situations – Native American Communities

In order to preserve anonymity amongst its community members, Native American communities may develop their own unique numbering system in place of a typical postal addressing scheme. The details of their unique numbering system must be included in their 9-1-1 Service Plan. The State 9-1-1 GIS Coordinator will review the 9-1-1 Service Plans on a case-by-case basis in order to allocate the required map layers. In all cases, the map layers must be capable of automatically locating **at least 95%** of 9-1-1 callers.

Spatial Accuracy Requirements

The advent of FCC Wireless Phase I and II wireless 9-1-1 has elevated the importance of having spatially accurate GIS data. With the implementation of Phase II, the location of the wireless caller is plotted on a digital map based on Latitude and Longitude (XY) coordinates provided to the PSAP via the Automatic Location Information (ALI). These XY coordinates will be determined by one of three technologies: 1) network-based (location determining equipment on each wireless tower), 2) handset-based (GPS receiver on the caller's mobile phone), or 3) combination of the network and handset-based solutions. The FCC has adopted accuracy requirements for the wireless caller's XY. These requirements are listed below in an excerpt from *FCC 01-351, Fifth Report and Order:*

> *The FCC adopted accuracy and reliability requirements for ALI as part of its rules for wireless carrier enhanced 911 (E911) service in CC Docket No. 94-102, Revision of the Commission's Rules to Ensure Compatibility with Enhanced 911 Emergency Calling Systems. Those rules were adopted in 1996 and revised in the Third Report and Order in that docket*

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(released October 6, 1999). The revised rules set the following accuracy and reliability requirements for E911 Phase II operations:

- *For network-based solutions: 100 meters for 67 percent of calls, 300 meters for 95 percent of calls;*
- *For handset-based solutions: 50 meters for 67 percent of calls, 150 meters for 95 percent of calls.*

Data Collection

These Arizona GIS standards require that the GIS centerline file be collected at a minimum of 7.6 meters 95% of the time. The scale of vector GIS data must be 1:24,000 or better and the scale of raster GIS data (digital orthoimagery, satellite imagery, etc) must be 1:2400 or better. It is recommended that updates to the centerline file be made with the most spatially accurate data and/or means available.

Map Projection

In a wireless Phase II environment, the wireless 9-1-1 caller's XY coordinates are provided to the PSAP in a WGS 84 datum. Thus, all 9-1-1 GIS map data must utilize projections that display coordinates in a WGS 84 datum.

Attribute Accuracy Requirements

The attribute information must be accurate in order for 9-1-1 calls to locate properly. Below is a list of attribution accuracy requirements:

Street centerlines

- ✓ The ALI database must have **at least a 95% match rate** to the GIS centerline layer
- ✓ Street name elements must be MSAG-valid
- ✓ All street segments must be broken and snapped at street intersections, ESN boundaries, and community boundaries
- ✓ Direction of street segment must follow real-world ranges
- ✓ Ranges may not overlap
- ✓ "To" range must be greater than "From" range on each street segment
- ✓ Street segments must be free of parity errors (i.e. – cannot have both even and odd ranges on the same side of a segment)
- ✓ Left and right ESN information must match boundary files

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✓ Divided highways, freeways, and streets (divided by median) must be depicted as two line segments

ESN and Community boundaries

✓ Must be free of sliver polygons (i.e. – gaps or tiny unwanted polygons)
✓ Must be snapped to street segments
✓ ESN boundaries must cover the 9-1-1 system's entire response area

Testing and Validation Methods

The GIS tests and validations may be performed by the State's 9-1-1 GIS Coordinator or the 9-1-1 System's GIS personnel. Before funding will be approved from the State's 9-1-1 Fund, each 9-1-1 System (city or county jurisdiction) will be required to send complete copies of the following GIS layers to the State 9-1-1 GIS Coordinator for validation. Tests will be run to ensure they meet Arizona's standards.

- Street centerlines
- ESN/ESZ boundaries
- Community boundaries

Data Sharing

All shared 9-1-1 GIS data shall be standardized prior to distribution. Please refer to the *NENA GIS Data Model* (see APPENDIX A) for standard field names, types, and lengths.

Ongoing GIS Maintenance

Maintaining accurate GIS data is as important as acquiring accurate GIS data. Since up-to-date GIS data is required for 9-1-1 mapping, it is imperative that the data be continually updated with new streets, sub-divisions, and annexations. Each 9-1-1 System is responsible for maintaining their GIS data. Below are maintenance requirements that must be met in order to receive State 9-1-1 funds to finance mapped ALI and wireless 9-1-1.

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- The 9-1-1 System must identify their GIS department or GIS data maintenance source and MSAG Coordinator prior to installing a mapped ALI system. A GIS maintenance procedure must be submitted to the State's 9-1-l Administrator or GIS Coordinator.

- Procedures for updating and correcting the GIS data must be developed prior to installing a mapped ALI system. These procedures include:

  - Methods for adding new streets and subdivisions
  - Timeline for adding new street data/annexations
  - Methods for collecting GPS points (if applicable)
  - Methods for adjusting ESN/Community boundaries

- The following people play a key role in maintaining the 9-1-1 GIS data:
  - 9-1-1 dispatchers and call takers
  - MSAG Coordinators
  - GIS personnel
  - Addressing assignment sources such as the Planning and/or Assessors Office
  - Outside contracted data maintenance sources

- To ensure that GIS data is accurately maintained, each 9-1-1 System is required to complete an annual ALI to GIS comparison. This comparison should be performed by the 9-1-1 System's GIS personnel or the State's 9-1-1 GIS Coordinator. Each county is entitled to one free ALI dump per year. 9-1-1 Systems may also perform a GIS to MSAG comparison to assess GIS accuracy.

- **Please contact the State 9-1-1 GIS Coordinator or 9-1-1 Project Manager if you need GIS assistance.**

APPENDIX A

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Street Centerline Field Structure (required for data sharing)

NAME	LABEL	LENGTH	TYPE*	DATA DESCRIPTION
Left Address Low	**FROM_ADD_L**	10	N	Lowest address on left side of street in ascending order
Left Address High	**TO_ADD_L**	10	N	Highest address on left side of street in ascending order
Right Address Low	**FROM_ADD_R**	10	N	Lowest address on right side of street in ascending order
Right Address High	**TO_ADD_R**	10	N	Highest address on right side of street in ascending order
Prefix Directional	**PRE_DIR**	2	T	Leading street direction prefix. Valid Entries: N S E W NE NW SE SW
Street Name	**STREET_NAME**	60	T	Valid service address of the Calling Party Number. May include Spanish street names, hyphens, and ampersands
Street Suffix	**STREET_TYPE**	4	T	Valid Street abbreviation, as defined by the US Postal Service: http://www.usps.com/ncsc/lookups/usps_abbreviations.html
Post Directional	**POST_DIR**	2	T	Trailing street direction suffix. Valid Entries: N S E W NE NW SE SW
Alternate Street Name	**ALT_NAME**	70	T	Alternate full street name
One way	**ONEWAY**	1	T	One way road classification. Blank or N = No Y = One way
MSAG Community Name Left	**MSAG_COMM_L**	35	T	Valid service community name as identified by the Master Street Address Guide on the left side of the street
MSAG Community Name Right	**MSAG_COMM_R**	35	T	Valid service community name as identified by the Master Street Address Guide on the right side of the street
Source of Data	**SOURCE**	20	T	Person or agency that last updated the record
Date Updated	**DLU**	10	N	Date of last update Format: CCYY-MM-DD

*N = Number   T=Text

APPENDIX B

From EXHIBIT 22
VERSION 1.0 GIS data model format

22.1 **Preface**

The *Geographic Information System (GIS) Data* Model identifies a geospatial data standard, but it outlines data layers for GIS data to be exchanged between neighboring public safety agencies or jurisdictions. This standard is for spatial datasets in a GIS environment. GIS utilizes linear style addressing technique for purposes of geocoding. Should an organization use non-linear style addressing such as an alphanumeric grid style system, this standard would not be effective. The primary purpose of this standard is for organizations that utilize a Geographic Information System.

This Standard will identify minimal attributes required in a spatial dataset, and define the structure of said attributes. This standard will help facilitate the development of new map products for use in Public Safety specifically as it pertains to implementing wireless locational technologies.

22.5B. Emergency Service Zone Boundary Layer

NAME	LABEL	MAX # BYTES	TYPE	DATA DESCRIPTION
Community ID	CID	10	N	Unique Community ID Number i.e. FIPS, GEOCODES, etc.
County ID	COI	5	AN	County Identification code (usually the FIPS code). *Note: County Identification field is used to identify the county of call origination. The Committee recommends use of the FIPS code assigned to each county by the U.S. Census Bureau*
PSAP ID	PSI	4	AN	Code identifying the PSAP associated with the assigned ESN
Agency ID	AID	9	N	Emergency Service Agency ID
ESN	ESN	5	N	Emergency Service Number associated with this House Number, Street Name and Community Name. *Note: The Service Provider, providing the E9-1-1 Selective Routing will assign ESN's.*
Source of Data	SOD	5	A	Agency that last updated the record
Date Updated	DLU	10	N	Date of last update Format: CCYY-MM-DD

22.5.C Municipal Boundary Layer

NAME	LABEL	MAX # BYTES	TYPE	DATA DESCRIPTION
Community ID	CID	10	N	Unique Community ID Number i.e. FIPS, GEOCODES, etc.
MSAG Community Name	MCN	35	A	Valid service community name as identified by the MSAG
Source of Data	SOD	5	A	Agency that last updated the record
Date Updated	DLU	10	N	Date of last update Format: CCYY-MM-DD

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APPENDIX C

Sample Metadata Form

ESN Boundaries
Metadata:

- Identification_Information
- Data_Quality_Information
- Spatial_Data_Organization_Information
- Spatial_Reference_Information
- Entity_and_Attribute_Information
- Distribution_Information
- Metadata_Reference_Information

Identification_Information:
Citation:
Citation_Information:
Originator: REQUIRED: The name of an organization or individual that developed the data set.
Publication_Date: REQUIRED: The date when the data set is published or otherwise made available for release.
Title:
ESN
Geospatial_Data_Presentation_Form: vector digital data
Online_Linkage: \\WSITENA\C$\Adam\GIS Data\Arizona.mdb
Description:
Abstract:
ESN Boundaries
Purpose:
REQUIRED: A summary of the intentions with which the data set was developed.
Time_Period_of_Content:
Time_Period_Information:
Single_Date/Time:
Calendar_Date: 11/16/2004
Currentness_Reference:
Publication date
Status:
Progress: REQUIRED: The state of the data set.
Maintenance_and_Update_Frequency: REQUIRED: The frequency with which changes and additions are made to the data set after the initial data set is completed.
Spatial_Domain:
Bounding_Coordinates:

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West_Bounding_Coordinate: -113.334221
East_Bounding_Coordinate: -110.450439
North_Bounding_Coordinate: 32.511578
South_Bounding_Coordinate: 31.507841
Keywords:
Theme:
Theme_Keyword_Thesaurus: REQUIRED: Reference to a formally registered thesaurus or a similar authoritative source of theme keywords.
Theme_Keyword: REQUIRED: Common-use word or phrase used to describe the subject of the data set.
Access_Constraints: REQUIRED: Restrictions and legal prerequisites for accessing the data set.
Use_Constraints:
REQUIRED: Restrictions and legal prerequisites for using the data set after access is granted.
Point_of_Contact:
Contact_Information:
Contact_Person_Primary:
Contact_Person:
Contact_Organization: State of Arizona/9-1-1 Office
Contact_Position: 9-1-1 GIS Coordinator or 9-1-1 Project Manager
Contact_Electronic_Mail_Address:
Native_Data_Set_Environment:
Microsoft Windows XP Version 5.1 (Build 2600) Service Pack 2; ESRI ArcCatalog 9.0.0.535

Data_Quality_Information:
Positional_Accuracy:
Horizontal_Positional_Accuracy:
Horizontal_Positional_Accuracy_Report:
<3 meters

Spatial_Data_Organization_Information:
Direct_Spatial_Reference_Method: Vector
Point_and_Vector_Object_Information:
SDTS_Terms_Description:
SDTS_Point_and_Vector_Object_Type: G-polygon
Point_and_Vector_Object_Count: 850

Spatial_Reference_Information:
Horizontal_Coordinate_System_Definition:
Geographic:
Latitude_Resolution: 0.000000
Longitude_Resolution: 0.000000
Geographic_Coordinate_Units: Decimal degrees

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Geodetic_Model:
Horizontal_Datum_Name: North American Datum of 1927
Ellipsoid_Name: Clarke 1866
Semi-major_Axis: 6378206.400000
Denominator_of_Flattening_Ratio: 294.978698
Vertical_Coordinate_System_Definition:
Altitude_System_Definition:
Altitude_Resolution: 0.000010
Altitude_Encoding_Method: Explicit elevation coordinate included with
horizontal coordinates

Entity_and_Attribute_Information:
Detailed_Description:
Entity_Type:
Entity_Type_Label: ESN
Attribute:
Attribute_Label: OBJECTID
Attribute_Definition:
Internal feature number.
Attribute_Definition_Source:
ESRI
Attribute_Domain_Values:
Unrepresentable_Domain:
Sequential unique whole numbers that are automatically generated.
Attribute:
Attribute_Label: Shape
Attribute_Definition:
Feature geometry.
Attribute_Definition_Source:
ESRI
Attribute_Domain_Values:
Unrepresentable_Domain:
Coordinates defining the features.
Attribute:
Attribute_Label: AREA
Attribute:
Attribute_Label: PERIMETER
Attribute:
Attribute_Label: NAME
Attribute:
Attribute_Label: ESN
Attribute:
Attribute_Label: Shape_Length
Attribute_Definition:
Length of feature in internal units.
Attribute_Definition_Source:
ESRI

Attribute_Domain_Values:
Unrepresentable_Domain:
Positive real numbers that are automatically generated.
Attribute:
Attribute_Label: Shape_Area
Attribute_Definition:
Area of feature in internal units squared.
Attribute_Definition_Source:
ESRI
Attribute_Domain_Values:
Unrepresentable_Domain:
Positive real numbers that are automatically generated.

Distribution_Information:
Resource_Description: Downloadable Data

Metadata_Reference_Information:
Metadata_Date: 20041117
Metadata_Contact:
Contact_Information:
Contact_Organization_Primary:
Contact_Organization: REQUIRED: The organization responsible for the metadata information.
Contact_Person: REQUIRED: The person responsible for the metadata information.
Contact_Address:
Address_Type: REQUIRED: The mailing and/or physical address for the organization or individual.
City: REQUIRED: The city of the address.
State_or_Province: REQUIRED: The state or province of the address.
Postal_Code: REQUIRED: The ZIP or other postal code of the address.
Contact_Voice_Telephone: REQUIRED: The telephone number by which individuals can speak to the organization or individual.
Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata_Standard_Version: FGDC-STD-001-1998
Metadata_Time_Convention: local time
Metadata_Extensions:
Online_Linkage: http://www.esri.com/metadata/esriprof80.html
Profile_Name: ESRI Metadata Profile