Quality Data. Quality Response.

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Next Generation 9-1-1:
It’s All About the Data

First Some Basic Acronyms We Will Be Using

- Next Generation 9-1-1 (**NG9-1-1**)
- Location Validation Function (**LVF**)
- Emergency Call Routing Function (**ECRF**)
- Emergency Services Routing Proxy (**ESRP**)
- Location Database (**LDB**)
- Location Information Server (**LIS**)
- Spatial Information Function (**SIF**)
- Presence Information Data Format – Location Object (**PIDF-LO**)
- Road Centerlines (**RCLs**)
- Address Points (**APs**)
- Emergency Service Zones (**ESZs**)

What We'll Cover Today

- Transitioning from Traditional: ALI to LDB / LIS and MSAG to LVF / ECRF.
- The 'Location Database' and its centralized role in NG9-1-1.
- CIDB and the 'Other' Stuff – Supplemental Data.
- LVF / ECRF Functionality and Data.
- The SIF and the Forest Guide
- Bridging the gap to the network: ESRPs, BCFs and the rest.
- NG9-1-1 GIS Data: How it Will (or Should) Work.
- GIS Related NENA Standards and Where They Stand.
- GIS Data: Review, Update and Maintain.
- Summation and wrap-up!

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Transitioning from Traditional

It's all about transition…

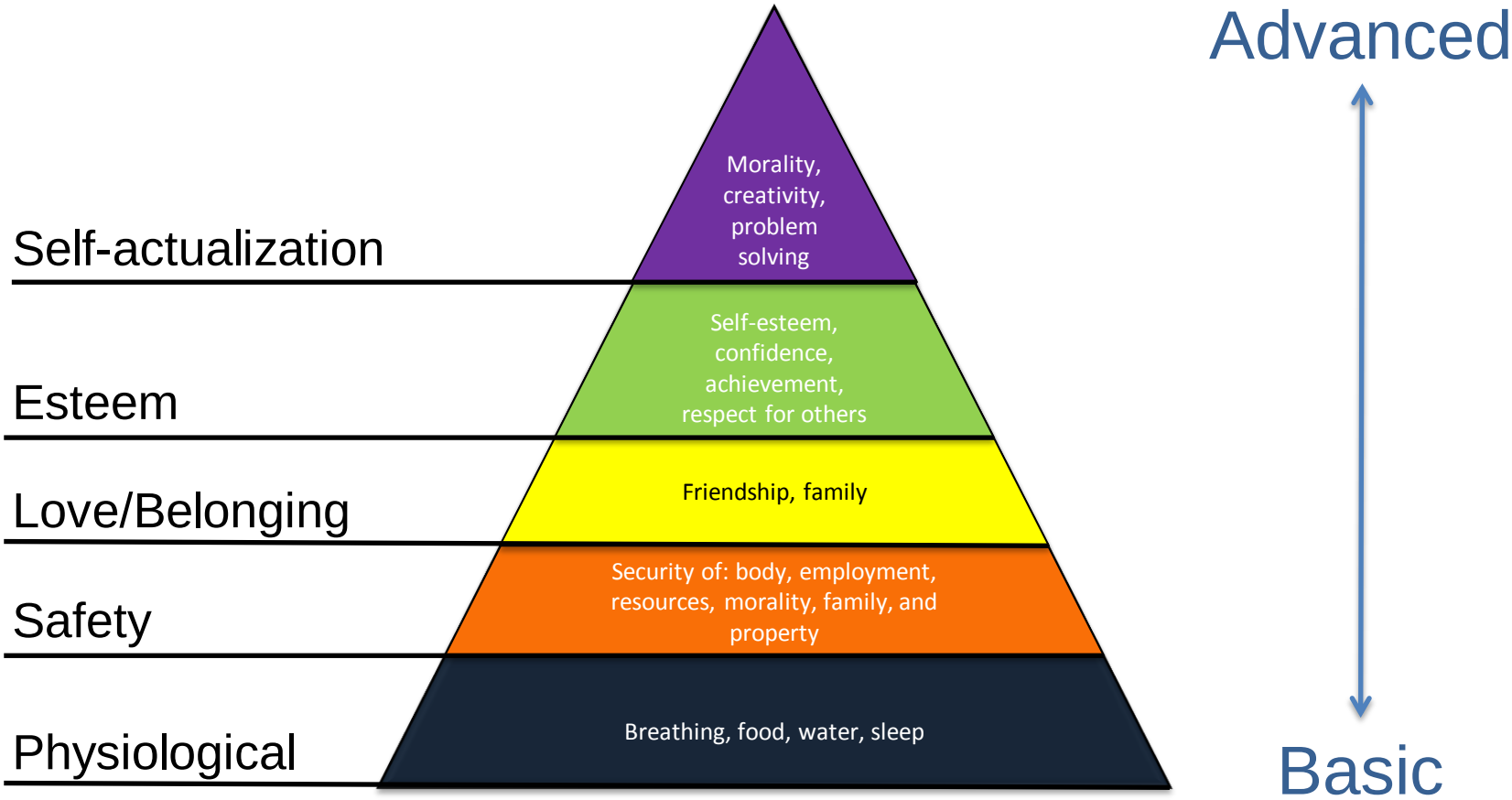
There is no knowledge of true being. The world is fundamentally in a state of becoming.

~ Nietzsche

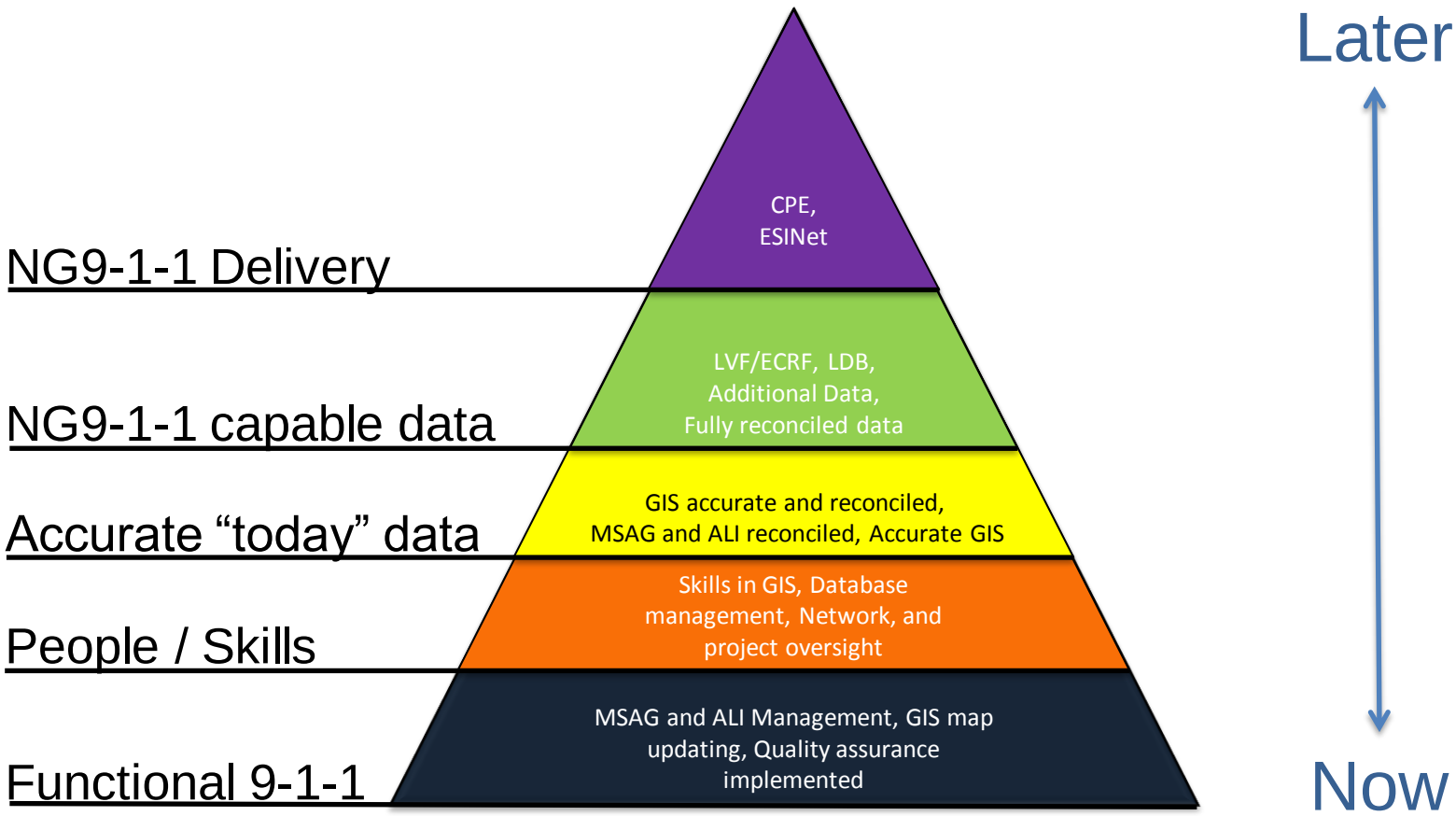
Development of ALI / MSAG vs. GIS

- ALI / MSAG
  - 1968 first 9-1-1 call placed in Haleyville, Alabama.
  - 1978 ANI is provided for the first time in Alameda, California.
  - 1980 ALI goes live in Orange County, Florida. (Enhanced 9-1-1)
  - MSAG developed to associate the proper responders to an address.
  - i3 establishes evolution of Enhanced 9-1-1 to an all IP based system.
- GIS – Geographic Information Systems
  - A combination of hardware, software and data used to answer questions.
  - 1960 first GIS system established in Canada (CGIS).
  - Esri founded in 1969.
  - ArcInfo application launched in 1982 as first modern GIS program.

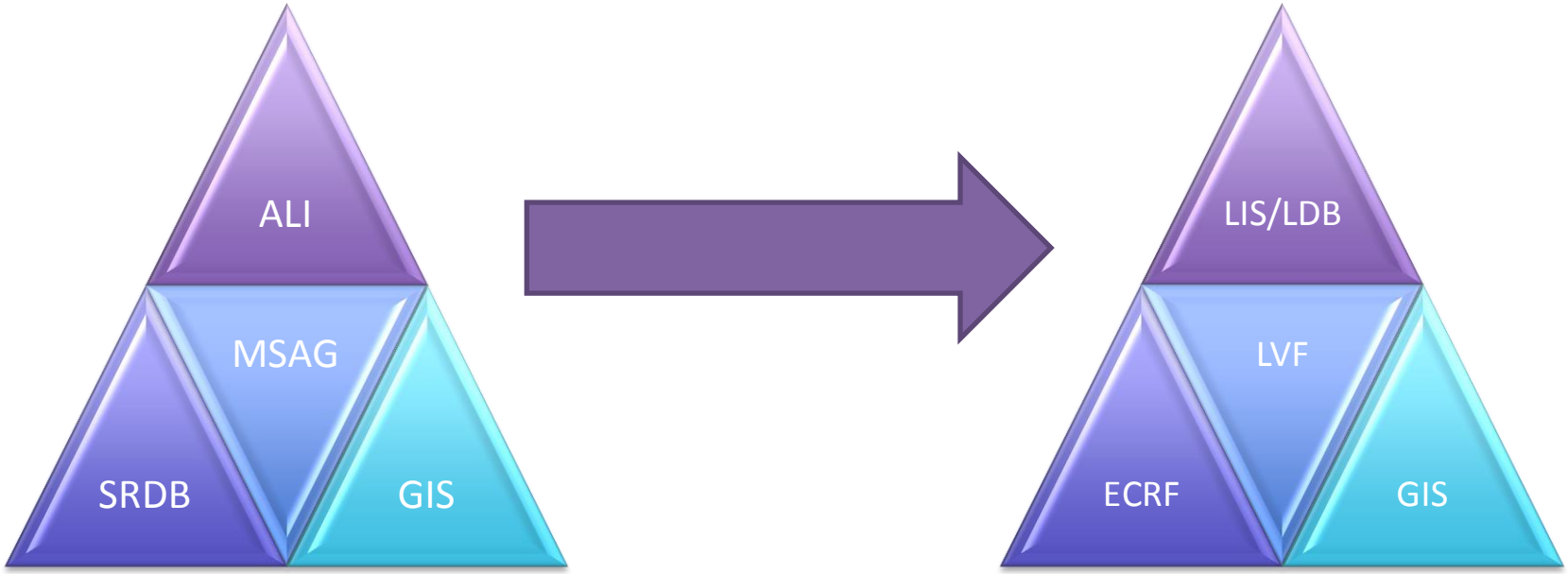
Maslow's Hierarchy of Needs



A NG9-1-1 Hierarchy of Needs Based on Time



Transitioning Data from Traditional to NG9-1-1 (high level)



Industry Approach to NG9-1-1

- Develop and deploy NG9-1-1 products that are a natural evolution of today's database environment:
  - ALI → LIS and LDB
  - MSAG and SRDB → LVF and ECRF

- Develop and deploy NG9-1-1 support products that are necessary to enable NG9-1-1 capable data:
  - Reference data → Reconcile MSAG, USPS, and GIS
  - Spatial data → Enhance GIS data to the levels required
  - Multi-Agency data → Combine and coalesce multiple GIS data sets

- Offer services to support data management of all types:
  - Database
  - LVF/ECRF
  - GIS

Data Use in NG9-1-1

- For Civic Addressing:
  - Presence Information Data Format-Location Object (**PIDF-LO**) will replace ALI with more location information that needs to match GIS.
  - More detailed location elements that describe street address information better than ALI did.
  - Not limited to 512 characters as ALI was
  - Work must be performed before new ALI technology is in place
    - “PIDF-LO”-ize current ALI records.
    - ‘Standardization’ of current GIS data (per NENA GIS Data Model)
- Geodetic Location:
  - Coordinates representing latitude and longitude of the call location (X / Y).

Data Use in NG9-1-1

- For Validation and Routing
  - An LVF / ECRF populated with only GIS data may not suffice during transition to NG9-1-1.
  - MSAG's Role
    - MSAG knowledge lives on and will be needed during transition.
    - MSAG replaced by LVF / ECRF once GIS, MSAG, and USPS converge
  - Additional "aliases" can add to the value of the data by adding USPS data. (ties to "consumer knowledge" of their location)

Data Assumptions

- NG9-1-1 call delivery is based on a set of assumptions regarding available data as well as its quality and content.
  - “First, Do No Harm”: Everything in NG9-1-1 will be as good as or better than E9-1-1.
  - A 9-1-1 call will either contain a location (or a reference where location can be obtained from a trusted source).
    - Civic
    - Geodetic
  - “Fixed” locations will have been pre-validated, in theory, against the same data that is used for call routing

Data Assumptions

- Call routing is driven largely by geographic data.
- An agency's GIS will comply with certain data model requirements with regards to attribution and coordinate system (WGS84).
  - May require some transformation for routing usage.
  - Will likely include some level of aggregation for a regional solution.
- Data exchange is accomplished by previously defined protocols:
  - HELD (IETF RFC 5985)
  - LoST (IETF RFC 5222)
- NENA did not want to invent new protocols where acceptable ones already existed.

Timing and Roadblocks for Data Transition

- Need to break the circular dependencies.
  - Example: Can't deploy NG9-1-1 until the service providers have a LIS. Service providers won't supply a LIS until there is demand.
- Deployments will be regional and look much different than the "end state":
  - Emphasis will be on moving calls/data between NG9-1-1 sites and traditional sites.
  - Network level "trust" will be on a one by one basis.
  - Forest Guide and other national coordinating features not likely for a while.
- Your data transition should start now – even if actual NG91-1 deployment is years away.
- Your neighbors and your service providers won't move as fast as you.

ALI vs. LIS

- ALI: Automatic Location Identification
  - Limited size and content.
  - A “de-normalized” data structure with data about the caller, location, and call characteristics.
  - Generally operated by an agency or by a 3rd party on behalf of the agency.
- LIS: Location Information Server
  - Based on HELD protocol to discover “locations” on a network.
  - Limited to location only.
  - Envisioned to be provided by the access provider and/or service provider.

The Reality of the LIS

- Access/service provider responsibility
  - Possible for service providers currently operating ALIs to “convert”, but what about the others? What about access providers (e.g., Mom and Pop ISP)?
- Location Only (thus requiring additional databases to be deployed in conjunction with LIS deployments)
- Contents unseen by 9-1-1 Authorities until call time
- Personal Opinions
  - The concept of access provider LISs will not materialize in a timely enough fashion for most NG9-1-1 deployments.
  - Additional data sources (call, location, caller) will not materialize in a timely enough fashion for most NG9-1-1 deployments.

All The "Other Stuff"

If LIS only provides location, where is the rest of my ALI spill?

- Call Information Database (CIDB): Specific details about a particular call (e.g., COS, Service Provider, CBN)
- Additional Caller Data:
  - Could be basic like ALI (caller's name)
  - Could be robust in the future (medical conditions, special needs, etc.)
  - Who will maintain this in a private manner?
- Additional Location Data:
  - Future cool stuff: links to blue prints, hazardous chemical alerts, etc.
  - Who will provide this and what is the business model?

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Location Database
(LDB)

Location Data Base (LDB): Transition and Beyond

- The definition of LIS has evolved from a local network element to that of an ALI replacement.
- Possible Scenarios:
  - A NG9-1-1 environment dominated by access provider LIS deployment is unlikely in the foreseeable future.
  - Service providers will migrate towards NG9-1-1 call delivery at their own pace.
  - Location and subscriber information will stay aggregated at approximately the same organizational level as ALI is today.
- The implementation of LDB allows the asynchronous migration of 9-1-1 functional elements to a NG9-1-1 environment.
  - No need to coordinate flash cuts PSAP CPE migrations
  - Gateways can be installed as needed
  - SR to ESRP migration can take its own course.

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The Call Information Database (CIDB)

What is the CIDB?

- Per 08-003, the Call Information Database (CIDB):
  - Is operated by a carrier or other service provider
  - Supplies the “Additional Call” data object.
  - The CIDB dereferences the URI passed in a Call-Info header and returns the AdditionalCall XML object.

- Per RFC: An emergency call must have a Call-Info header with a URI that resolves to an AdditionalCall Data structure.

CIDB Discussion: What is this?

210 555 1212 RES 14 12:34 FREDDY'S
FROZEN CUSTARD & ST 17400 A
210 555 1212 N NORTHWEST MILITARY
PKWY HILL COUNTRY PLAZA
12345 TX SHAVANO PARK
ATT
BEXAR COUNTY SHERIFF SAN ANTONIO FD
NORTH BEXAR EMS

CIDB Summary

- Initial data elements have been drafted as part of IETF documentation.
- XML structures not defined by NENA.
- No incentive for service providers to move to SIP (Session Initiation Protocol), much less operate a CIDB for dereferencing.
- Best solution is to use a LDB to mimic during transition.

As ALI

NPA	210
NXX	555
Calling Number	1212
Class of service	RES
Date	072914
Time (hh:mm)	12:34
Customer Name	Freddy's Frozen Custard & Steakburgers
House Number	17400
House Number Suffix	A
Main NPA	210
Main Number -	555
Main Number	1212
Prefix Directional	N
Street Name	Northwest Military
Street Suffix	PKWY
Location	Hill Country Plaza
ESN	12345
State	TX
Community Name	Shavano Park
Company ID1	ATT
Law Info 1	Bexar County Sheriff
Fire Info 1	San Antonio FD
EMS Info 1	North Bexar EMS

Splitting for NG9-1-1

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LIS

CIDB

Additional Caller Data

Additional Location Data

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* Indicates if VOIP Call

LIS

CIDB

Additional Caller Data

Additional Location Data

CIDB – A Wealth of Information…

- Data Provider Information
  - Data Provider String
  - Data Provider ID
  - Data Provider ID Series (For North America, hard coded to “NENA”)
  - Type of Data Provider (Telecom, Telematics, Language Translation, Relay, etc.)
  - Data Provider Contact URI
  - Data Provider Languages(s) Supported
  - xCard of Data Provider
  - Subcontractor Principal
  - Subcontractor Priority
- Service Information
  - Service Environment
  - Service Type (POTS, Wireless, VOIP, Coin, Prison, etc.)
  - Service Mobility Environment (Mobile, Fixed, Nomadic, Unknown)
- Device Information
  - Device Classification (Satellite, Desktop, Laptop, Tablet, Alarm, Aircraft, Marine, etc.)
  - Device Manufacture
  - Device Model Number
  - Unique Device Identifier
  - Device/Service Specific Additional Data Structure

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LIS

CIDB

Additional Caller Data

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LIS

CIDB

Additional Caller Data

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LIS

CIDB

Additional Caller Data

Additional Location Data

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LVF / ECRF

What is an LVF?

- Establish a single, authoritative source for location validation.
- Currently VoIP carriers validate addresses based on their own reference data and may not result in an MSAG valid location being delivered to the PSAP.
  - Provides landline equivalency for VoIP and all carrier types.
- Often, the MSAG is effectively “owned” by the carrier. A hosted solution allows the 9-1-1 Authorities to “own” the validation source without having to own the infrastructure.

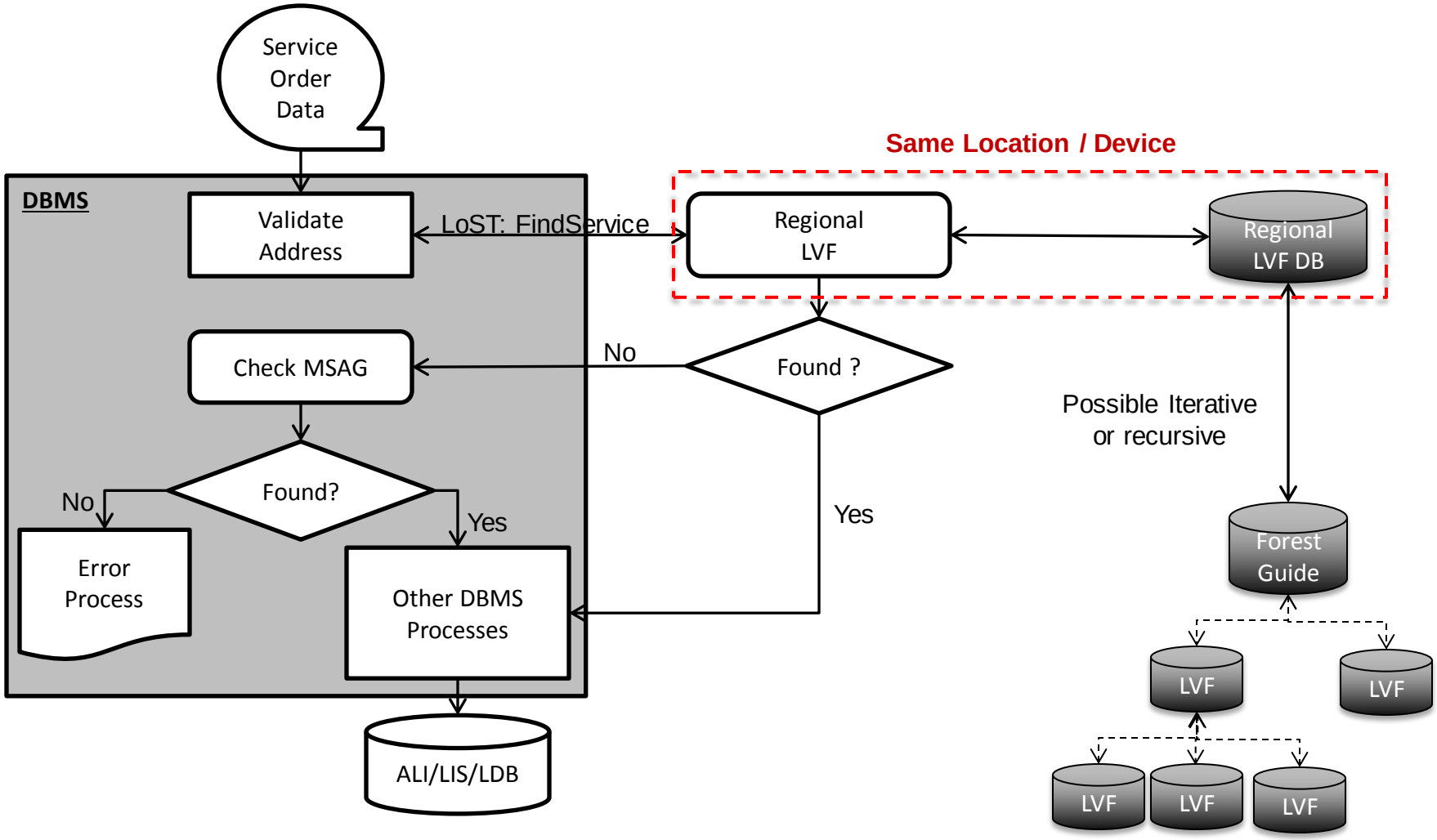
What is an ECRF?

- A server-to-server function that, when presented with a valid location, will deliver the “next hop” in 9-1-1 call delivery.
- Ideally should utilize the same data that is used by the LVF for validation.
- Both LVF and ECRF utilize the LoST protocol (Location to Service Translation)
  - Consists of a finite set of request types. Most common is a “findService” which returns the next hop (which is often the destination PSAP).
  - LoST queries can traverse a “tree” to get answers from other LVF/ECRFs

LVF / ECRF Functionality Goals

- Establish a single, authoritative source for location validation
- Ensure congruency between MSAG, Postal, and GIS data
- Provides landline equivalency for all carrier types.
  - MSAG or better
- Support for required standards:
  - IETF RFC 5582: Location-to-URL Mapping Architecture and Framework
  - IETF RFC 5031: A URN for Emergency and Other Well-Known Services
  - IETF RFC 4119: A Presence-based GEOPRIV Location Object Format
  - IETF RFC 5130: Presence Information Data Format Location Object (PIDF-LO)
  - NENA STA-005 (Draft): NENA Standards for the Provisioning and Maintenance of GIS data to ECRF/LVF
  - NENA 08-003 v1: Detailed Functional and Interface Specification for the NENA i3 Solution

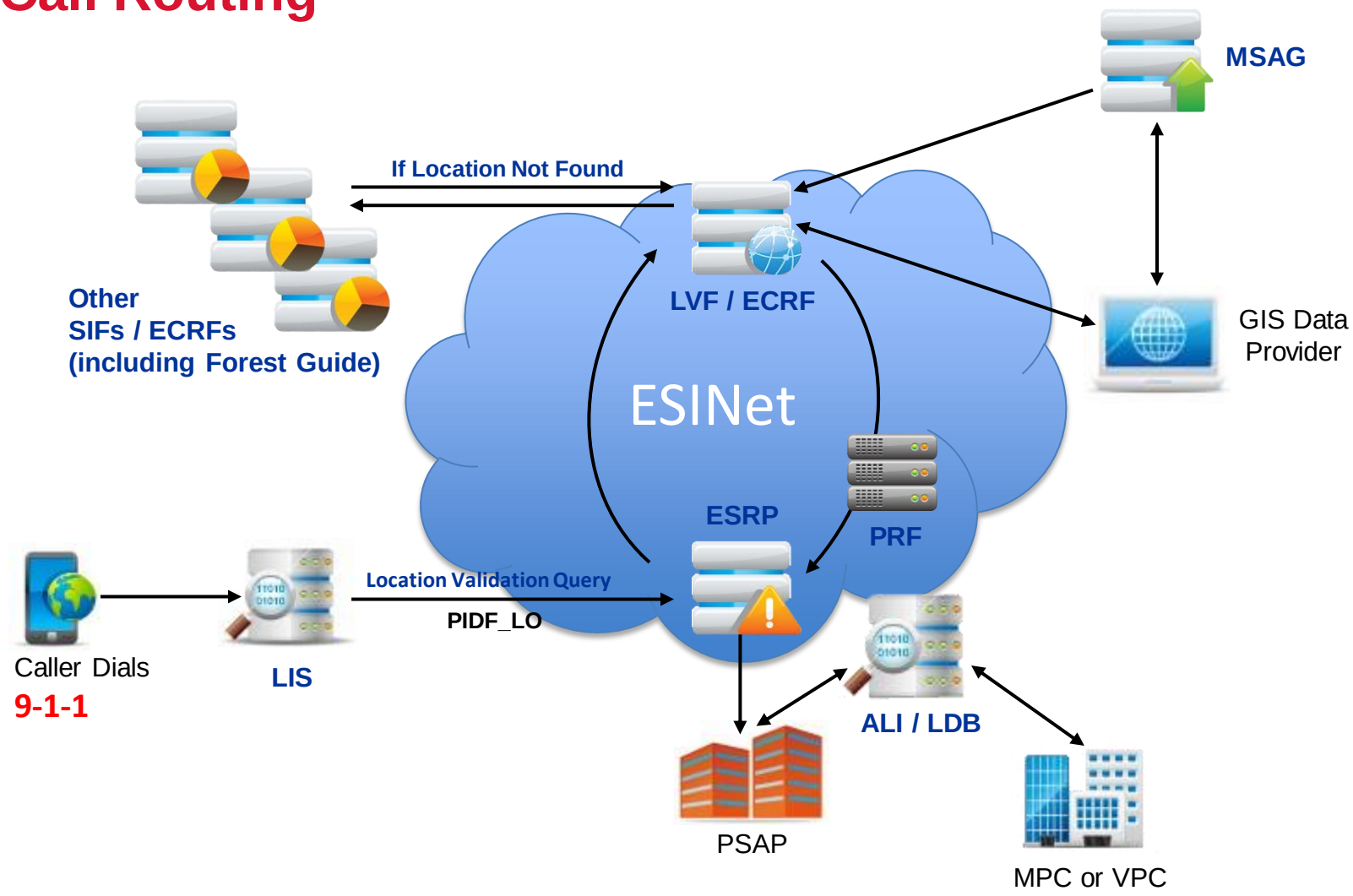
LVF enabling your current DBMS



LVF / ECRF and 9-1-1 Operations Implications

- Location Validation Function (LVF) / Emergency Call Routing Function (ECRF) - A functional element that takes GIS data and makes it available via a “machine-to-machine” interface that allows for civic address validation and 9-1-1 call (text, video, etc.) delivery.
- Key factors:
  - Eventually replaces MSAG (imperative to not lose information in the conversion)
  - Enables an IP network to be an ESInet (routing calls across a network is key requirement)
- Responsibility:
  - Data originates locally, combined regionally, and known nationally.
  - Discrepancies must be fixed in a near immediate fashion to avoid misroutes.

i3 Call Routing

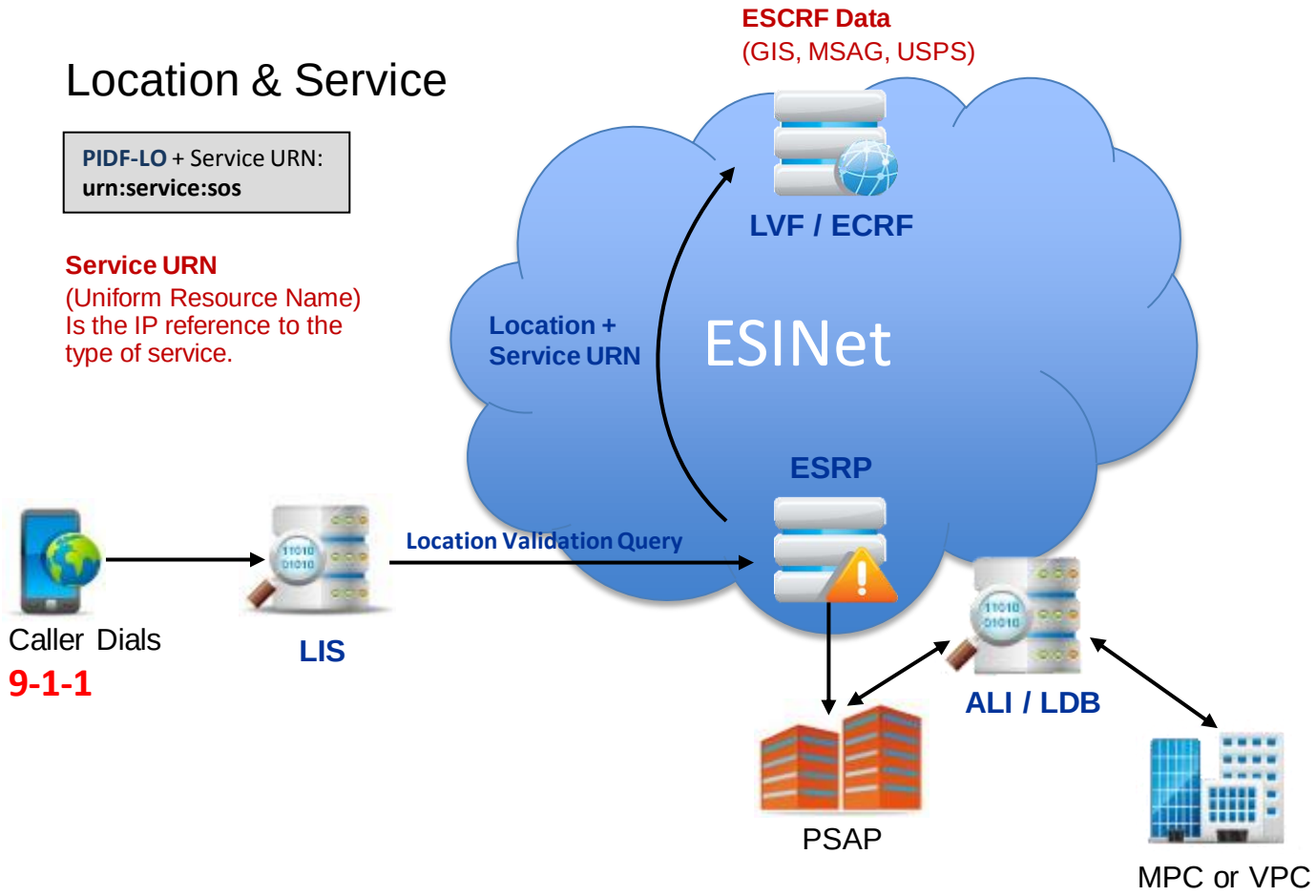


i3 Call Routing – in to the ECRF

Location & Service

PIDF-LO + Service URN:
urn:service:sos

Service URN
(Uniform Resource Name)
Is the IP reference to the type of service.



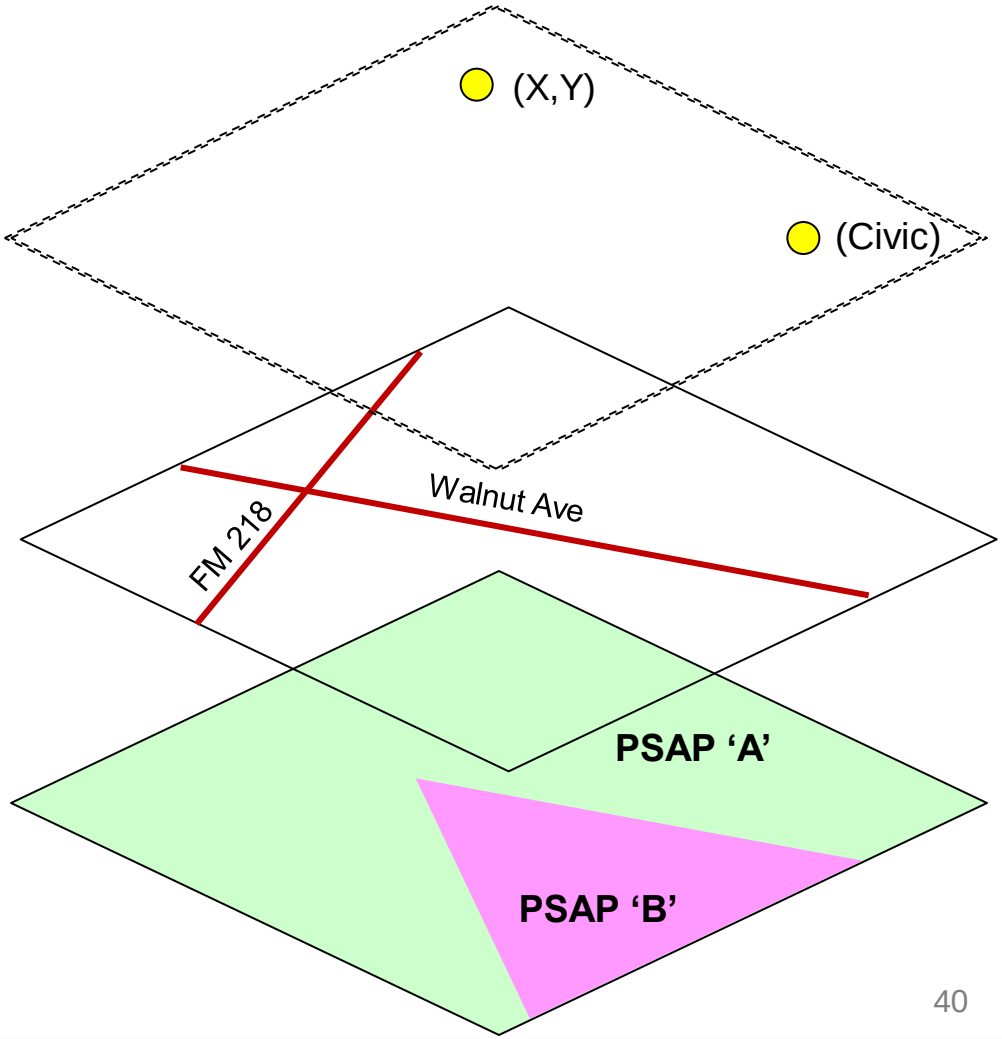
Point-in-Polygon Analysis for NG9-1-1

Method 1:

'Geodetic' location (X, Y coordinates) are compared to the Polygon layer representing PSAPs to route to.

Method 2:

'Civic' location geocoded to RCL layer then compared to the Polygon layer representing PSAPs to route to.



i3 Call Routing – Out of the ECRF

Location & Service

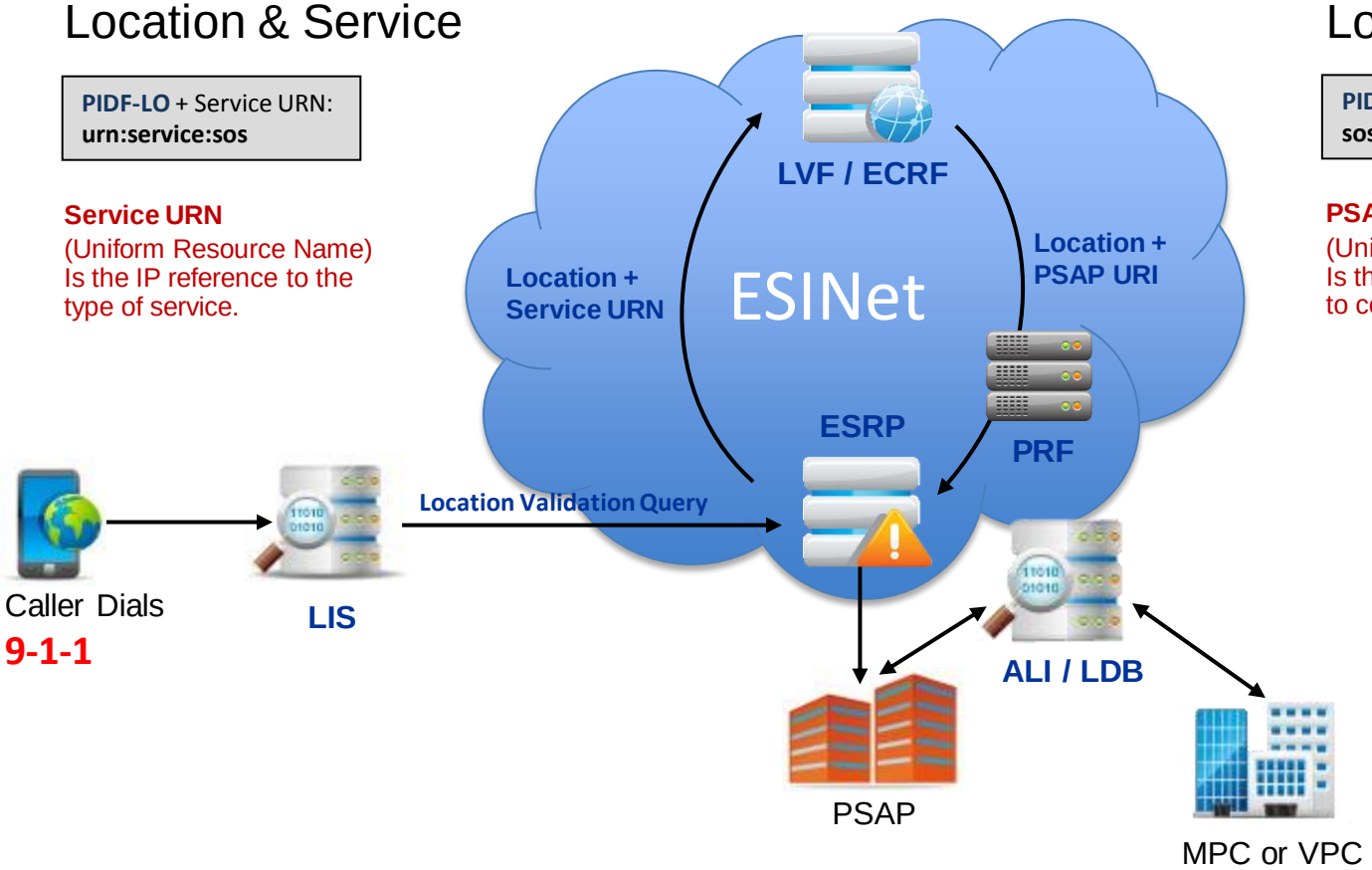
PIDF-LO + Service URN:
urn:service:sos

Service URN
(Uniform Resource Name)
Is the IP reference to the type of service.

Location & PSAP

PIDF-LO + PSAP URI:
sos@psap.austin.tx.us

PSAP URI
(Uniform Resource Identifier)
Is the identifier of the PSAP to connect the call to.



End State: A LVF / ECRF is the center of NG9-1-1

- When a i3 infrastructure is deployed, LVF / ECRF (LoST) servers are the key function for validation and call delivery:
  - The LVF validates all civic locations prior to inclusion in a LIS, ALI or LDB.
  - The ECRF provides real time routing instructions for all call types.
- No subscribers get provisioned and no calls get delivered without the LVF / ECRF.
- The LVF / ECRF also serves as a critical element during transition:
  - Merges MSAG, Postal, and GIS into a reference source that can be used for provisioning an ALI, LIS or LDB.
  - Allows for migration to ESRPs even with legacy PSAPs.
- The LVF / ECRF can be launched with just MSAG data.

The Continuing Importance of Postal Data

- USPS data's role in the past
  - 1775 under Second Continental Congress (B. Franklin Postmaster General)
  - Provides postal delivery services within the U.S.
- USPS data's role in the future for 9-1-1
  - Bridges the gap between citizens' location determination (where my mail gets delivered) and 9-1-1 reference data (MSAG and GIS).
  - Serves as a check that no usable and reference-able locations have been excluded from 9-1-1.

Fredric Rolando, president of the National Association of Letter Carriers, agrees that Congress should get rid of the 2006 mandated payment but says it would be "irresponsible to degrade services to Americans and their businesses" just as postal delivery is rebounding with the economy. Because more people are shopping online, "the Internet is now a net positive for USPS, auguring well for the future as e-commerce grows," Rolando said in a statement.

Why Involve Postal and GIS…An example

- Avenue of the Americas is a major thoroughfare in New York City.
  - Originally labeled as Sixth Avenue when designed in 1811.
  - It was renamed to Avenue of the Americas in 1945.
  - Despite this renaming, most New Yorkers still refer to it as Sixth Avenue.
- Let's assume for the sake of this example that the MSAG, USPS, and GIS databases contain:

Source	Low	High	Street	Suffix
MSAG	1	1400	Avenue of the Americas	
USPS	1	1400	Sixth	Ave
GIS	1	1400	6th	Ave

- What is the effect on trying to validate the '1000' address for this street?

Validation Summary

LVF Content→ / Data Presented to LVF↓	MSAG Only	GIS Only	MSAG & GIS	MSAG, GIS, & USPS
MSAG Valid	Valid	Maybe Valid	Valid	Valid
USPS Valid	Maybe Valid	Maybe Valid	Maybe Valid	Valid
GIS Valid	Maybe Valid	Valid	Valid	Valid
Success Rate	33% - 100%	33% - 100%	66% - 100%	100%

- Which one is correct? What if we use only MSAG data? Only GIS data?
- LVF / ECRF should leverage all available legacy data during transition to NG 9-1-1.

Key NG9-1-1 Database Issues / Opportunities Facing Us

Making a “Field of Dreams” into Reality will Require:

- Building Realistic LVF / ECRF Data
- Evolving ALI and DBMS
- Ensuring Performance Parity of Third Party Data Sources
- Bringing Service Providers into the Fold

LVF / ECRF

Information is not knowledge.

~ Albert Einstein

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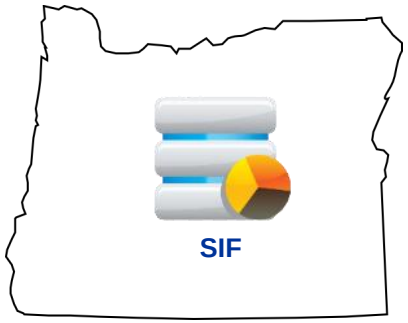
SIF & Forest Guide

The Spatial Information Function or 'SIF'

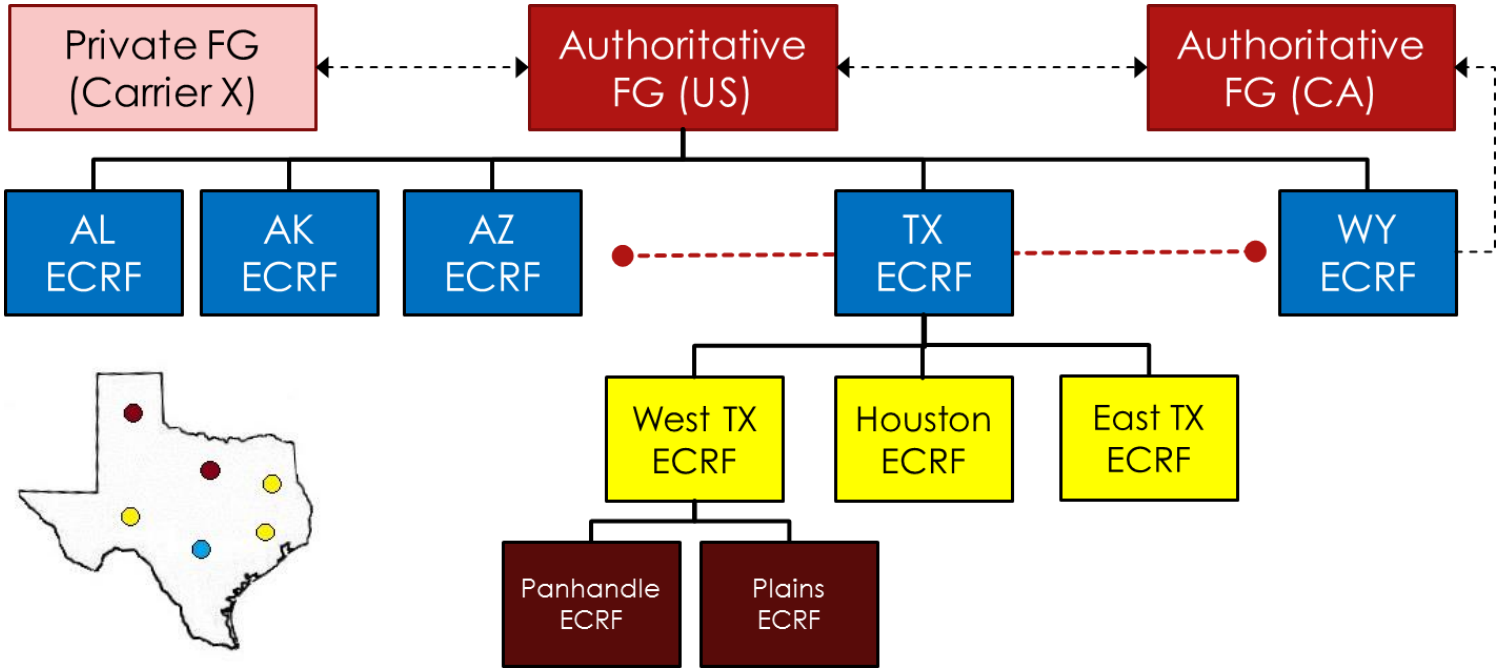
- Provides an interface between an authoritative copy of GIS data and functional elements within an ESInet (ex. LVF / ECRF).
- Some design considerations:
  - Centralized data repository for multiple entities.
  - Supports Districts, COGs and States.
  - The best location to perform 'edge matching'.
  - Various types of local government access will be required as well as data format support.
  - NENA standards should be supported by any SIF.
  - Who's responsible?



Forest Guide

- The Forest Guide is a single authoritative connection point for all ECRFs in its' country.
- ECRFs are deployed in a hierarchical "tree" fashion. The Forest Guide knows the coverage for all "trees" in a single country.
- Eventually each national FG must know about other national FGs (e.g. US and Canada share coverage regions).
- Necessary to "stitch together" regional (county, state, etc.) NG9-1-1 deployments into a seamless system.
- Who will sanction and pay for a national FG in the U.S. is to be determined. Likely suspects: FCC, DOT, NENA

Forest Guide Example



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NENA GIS Documents Status:

Standard, Requirements, & Informational

The Known vs. The Unknown

- The standards required to build the future are not complete.
- No one has, or can, have everything worked out at this point.
- State and local governments must move forward.
- Private industry must move forward.
- Information is key for both the public and private sectors.
- Local governments decide what needs to be done.

Need vs. Availability

- What is needed?
- What is being done now?
- What is the timeframe for standards and guidelines availability?
- Impact on local governments:
  - Accountability
  - Funded / Unfunded Mandates
  - Limitations of resources, budgets and experience
  - Government knowledge vs commercial sector training / development

NENA Document Types

NENA Document Development and Approval Process NENA-ADM-002.1

- NENA Administrative Document (ADM)

  Provides for the organizational structure of the association and its committees, establish the process of document development and approval, and provide the appropriate forms to document committee work.

- NENA Standard Document (STA)

  Published as an information source for the use of the public safety industry at large.

- NENA Requirements Document (REQ)

  Published as an information source for the use of the public safety industry at large regarding the design and analysis of system components.

- NENA Information Document (INF)

  Used to distribute information on a particular subject to the public

Previous GIS Related Documents

2002

A Public Safety Answering Point Manager's Guide to Geographic Information Technology (White Paper)

2002-2011

Standard Data Formats For 9-1-1 Data Exchange & GIS Mapping NENA 02-010 (STA)

2007

GIS Data Collection and Maintenance Standards NENA 02-014 (STA)

2009

Information Document for GIS Database to MSAG & ALI Synchronization Process NENA 71-501 (INF)

2014

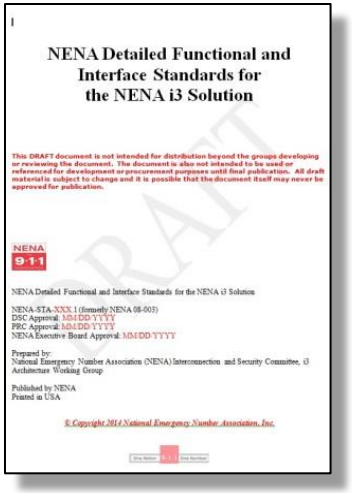
CLDXF – Civic Local Data Exchange Format (STA)

Upcoming Workgroup Documents

- i3 Architecture Workgroup NENA 08-003 (STA – Undergoing Revision)
- NG9-1-1 GIS Data Model Workgroup (STA – Under Review within NENA)
- Site Structure Address Point Workgroup (INF – In Development)
- Provisioning and Maintenance of GIS data to ECRF / LVF Workgroup (STA - Undergoing Revision)
- Data Management Workgroup (REQ - Undergoing Revision)
- Forest Guide Workgroup (Recently approved and available as INF-009)
- Members are still needed in most workgroups!

i3 Architecture (NENA 08-003)

- Detailed Functional and Interface Specification for the NENA i3 Solution (one 340+ page doc?).
- A work in progress – v2 comments accepted in May 2014.
- A selection of GIS related points of interest:
  - Appendix B schema vs. NG9-1-1 GIS Data Model schema.
  - ‘Real time’ or ‘Near real time’ requirements.
  - Gap determination process not firm (threshold?).
  - Data beyond jurisdiction marked with “Informative” attribute for ECRF/LVF to ignore.
  - Replication distribution authorization: SIF or ECRF control?
  - Map Viewer Service required but not defined.
  - Map Database Functional Element now being defined.



NENA Detailed Functional and Interface Standards for the NENA i3 Solution

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NENA 9-1-1

NENA Detailed Functional and Interface Standards for the NENA i3 Solution

NENA-STA-XXX.1 (formerly NENA 08-003)
DSC Approval: MM/DD/YYYY
PRC Approval: MM/DD/YYYY
NENA Executive Board Approval: MM/DD/YYYY

Prepared by:
National Emergency Number Association (NENA) Interconnection and Security Committee, i3 Architecture Working Group

Published by NENA
Printed in USA

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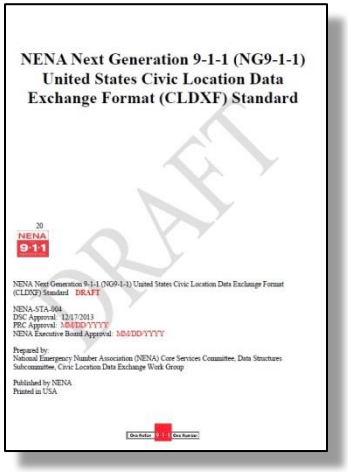
CLDXF - Civic Location Data eXchange Format

Developed to support the exchange of United States civic location address information about 9-1-1 calls, both within the US and internationally

- Definitive core civic location data elements that support emergency call routing and dispatch.
- Provides illustrative examples of address parsing.
- Maps a profile between Presence Information Data Format-Location Object [1] (PIDF-LO) and those same NENA core civic location data elements.
- Maps those civic location data elements to the corresponding ‘Federal Geographic Data Committee, United States Thoroughfare, Landmark, and Postal Address Data Standard’, Document Number FGDC-STD-016-2011 [9] set of data elements (sponsored by URISA and NENA).
- Follows the PIDFLO in providing a structured set of six elements to hold subaddress information: Building, Floor, Unit, Room, Seat, and Additional Location Information.


NENA Next Generation 9-1-1 (NG9-1-1) United States Civic Location Data Exchange Format (CLDXF) Standard

DRAFT

20

NENA 9-1-1

NENA Next Generation 9-1-1 (NG9-1-1) United States Civic Location Data Exchange Format (CLDXF) Standard DRAFT

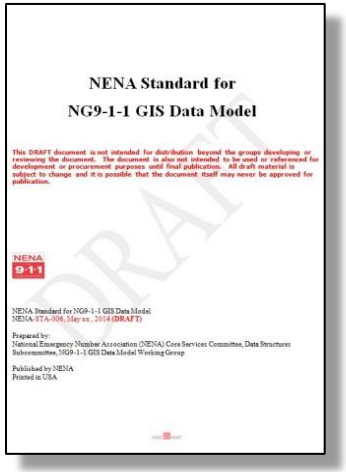
NENA-STA-004
DSC Approval: 12/17/2013
PRC Approval: MM/DD/YYYY
NENA Executive Board Approval: MM/DD/YYYY

Prepared by:
National Emergency Number Association (NENA) Core Services Committee, Data Structures Subcommittee, Civic Location Data Exchange Work Group

Published by NENA
Printed in USA

NG9-1-1 GIS Data Model

- Supports NG9-1-1 systems, databases, call routing, call handling, and related processes as well as PIDF-LO.
- NG9-1-1 GIS Data Model database schemas for:
  - Road Centerlines (required)
  - Emergency Service Boundaries such as PSAP and Responder (required)
  - State, County, Municipal Division Boundaries
  - Site / Structure Address Points
  - Others
- 'Authoritative' designation (layer or attribute?).
- 'Effective' and 'Expiration' dates.
- Common places and landmarks included.
- CLDXF consistency being reviewed / debated (CLDXF already compared to FGDC).


NENA Standard for
NG9-1-1 GIS Data Model

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NENA 9-1-1

NENA Standard for NG9-1-1 GIS Data Model
NENA-STA-006, May xx, 2014 (DRAFT)

Prepared by:
National Emergency Number Association (NENA) Core Services Committee, Data Structures Subcommittee, NG9-1-1 GIS Data Model Working Group

Published by NENA
Printed in USA

Site / Structure Address Point (SSAP)

WG formed August 2012 to create guide for placement of site / structure address points in a GIS.

- What makes an address location valid or invalid (structures, driveways, boundary lines)?
- Document structure:
  - Purpose & scope
  - Benefits / Impacts for guidelines
  - Acronyms / Abbreviations
  - Site / Structure Address Point usage in public safety applications (matrix)
  - Address Points vs. Access Points
  - Subaddressing
  - Placement methodologies based on: Parcels, Property Access, Structures, Sites, Geocoding
  - Accuracy
  - Best Practices
  - Metadata
  - References
- Draft completion target date - Fall 2014 NDC (October)

NENA Information Document for Development of Site/Structure Address Point GIS Data for 9-1-1

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NENA 9-1-1

NENA Information Document for Development of Site/Structure Address Point GIS Data for 9-1-1

NENA-INF-XXX
DSC Approval: MM/DD/YYYY
PRC Approval: MM/DD/YYYY
NENA Executive Board Approval: MM/DD/YYYY

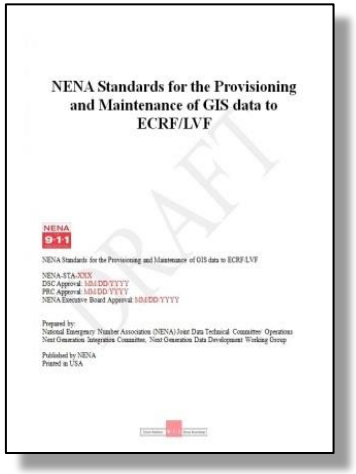
Prepared by:
National Emergency Number Association (NENA) Core Services Committee, NG Data Management Sub-Committee, and Site/Structure Address Points (SSAP) Workgroup

Published by NENA
Printed in USA

DRAFT

Provisioning and Maintenance of GIS data to ECRF / LVF

- Defines operational processes & procedures necessary to support the i3 Emergency Call Routing Function and Location Validation Function.
- Undergoing workgroup edits following internal and public reviews.
- A few key sections:
  - 4.1 Authoritative GIS Data Sources
  - 4.2 Required GIS Datasets
  - 4.5 GIS Data Standards (accuracy per NENA 02-014)
  - 4.6 GIS Data Recommendations, Tradeoffs, and NENA Long Range Vision (Z coordinate)
  - 4.7 GIS Data QA / QC Recommendations (QA / QC per NENA 02-014)
  - 5.2 Provisioning Roles and Responsibilities
  - 5.3.4 GIS Data 'Effective' and 'Expiration' Attributes


NENA Standards for the Provisioning and Maintenance of GIS data to ECRF/LVF

DRAFT

NENA 911

NENA Standards for the Provisioning and Maintenance of GIS data to ECRF/LVF

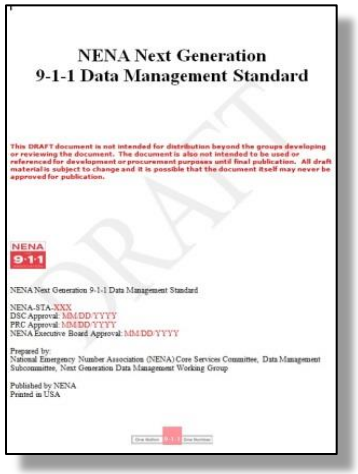
NENA-STA-XXX
DSC Approval: MM/DD/YYYY
PRC Approval: MM/DD/YYYY
NENA Executive Board Approval: MM/DD/YYYY

Prepared by:
National Emergency Number Association (NENA) Joint Data Technical Committee/ Operations Next Generation Integration Committee, Next Generation Data Development Working Group

Published by NENA
Printed in USA

NG9-1-1 Data Management

- Changing from Standards to Requirements.
- Reports are broken down into 17 Discrepancy and 7 Performance.
- Six reports relate directly to GIS data:
  - SIF Operator to the 9-1-1 Authority on provisioning GIS data
  - ECRF / LVF Operator to SIF Operator or Data Provider on GIS data provisioning
  - ECRF / LVF Operator to DR Subscribers on GIS gaps and overlaps
  - PSAP / Entity to 9-1-1 Authority on misroute to their PSAP/Entity [where GIS related]
  - PSAP to the GIS Provider when issues found in map display
  - Provisioning Performance Report related to GIS Data



NENA Next Generation
9-1-1 Data Management Standard

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NENA 9-1-1

NENA Next Generation 9-1-1 Data Management Standard

NENA-STA-XXX
DSC Approval: MM/DD/YYYY
PRC Approval: MM/DD/YYYY
NENA Executive Board Approval: MM/DD/YYYY

Prepared by:
National Emergency Number Association (NENA) Core Services Committee, Data Management Subcommittee, Next Generation Data Management Working Group

Published by NENA
Printed in USA

NG9-1-1 Data Management - cont -

Report Contents

- Title
- Description
- Table
  - Where discrepancy report created
  - Who has the responsibility to produce report
  - What is being reported
  - Turn around time to produce report
  - Who will be receiving report
  - Entity Responsible for resolution
  - Turn around time to resolve (From near real time to 1 or 3 business day?)
  - Turnaround time from referral
- Minimum Content Requirements

Vertical or 'Z' Values in NG9-1-1

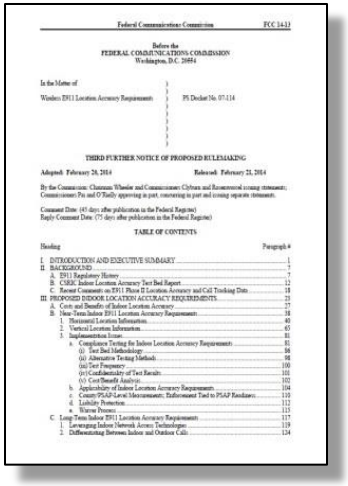
Legislating elevation / height

- Proposed rules for indoor location determination as of 2/20/2014 (FCC-14-13A1):
  - "Propose to add a requirement for provision of vertical location (Z-axis or elevation)".
  - Vertical location (Z-axis) within 3 meters of the caller for 67 percent of indoor 911 calls within three years of the adoption of rules, and for 80 percent of calls within five years.
- A NENA response was provided July, 2014. Some key points were (PS Docket no 07-114):
  - Require accuracy standards now (all handsets in 5 years).
  - Vertical indoor accuracy needs can be met using a combination of technologies.
  - Barometry can be used by public safety agencies in the short term.
  - Economies of scale will reduce the cost but only once a mandate is in place.

Vertical or ‘Z’ Values in NG9-1-1

Representing elevation / height

- Included in both the ‘NG9-1-1 GIS Data Model’ and the ‘Provisioning and Maintenance of GIS data to ECRF / LVF’ standards.
- Measuring - elevation in feet / meters, above ground / sea level, floors, barometric pressure?
- How can ‘Z’ value be used most effectively to convey location to users?
- Should data be available first or systems to utilize it?
- Developing / Maintaining data representing elevation.



Federal Communications Commission FCC 14-13

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of

Wireless E911 Location Accuracy Requirements | PS Docket No. 07-114

THIRD FURTHER NOTICE OF PROPOSED RULEMAKING

Adopted: February 20, 2014 Released: February 21, 2014

By the Commission: Chairman Wheeler and Commissioner Clyburn and Rosenworcel issuing statements; Commissioner Pai and O'Rielly approving in part, concurring in part and issuing separate statements.

Comment Date: (45 days after publication in the Federal Register)
Reply Comment Date: (75 days after publication in the Federal Register)

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Section Wrap-up

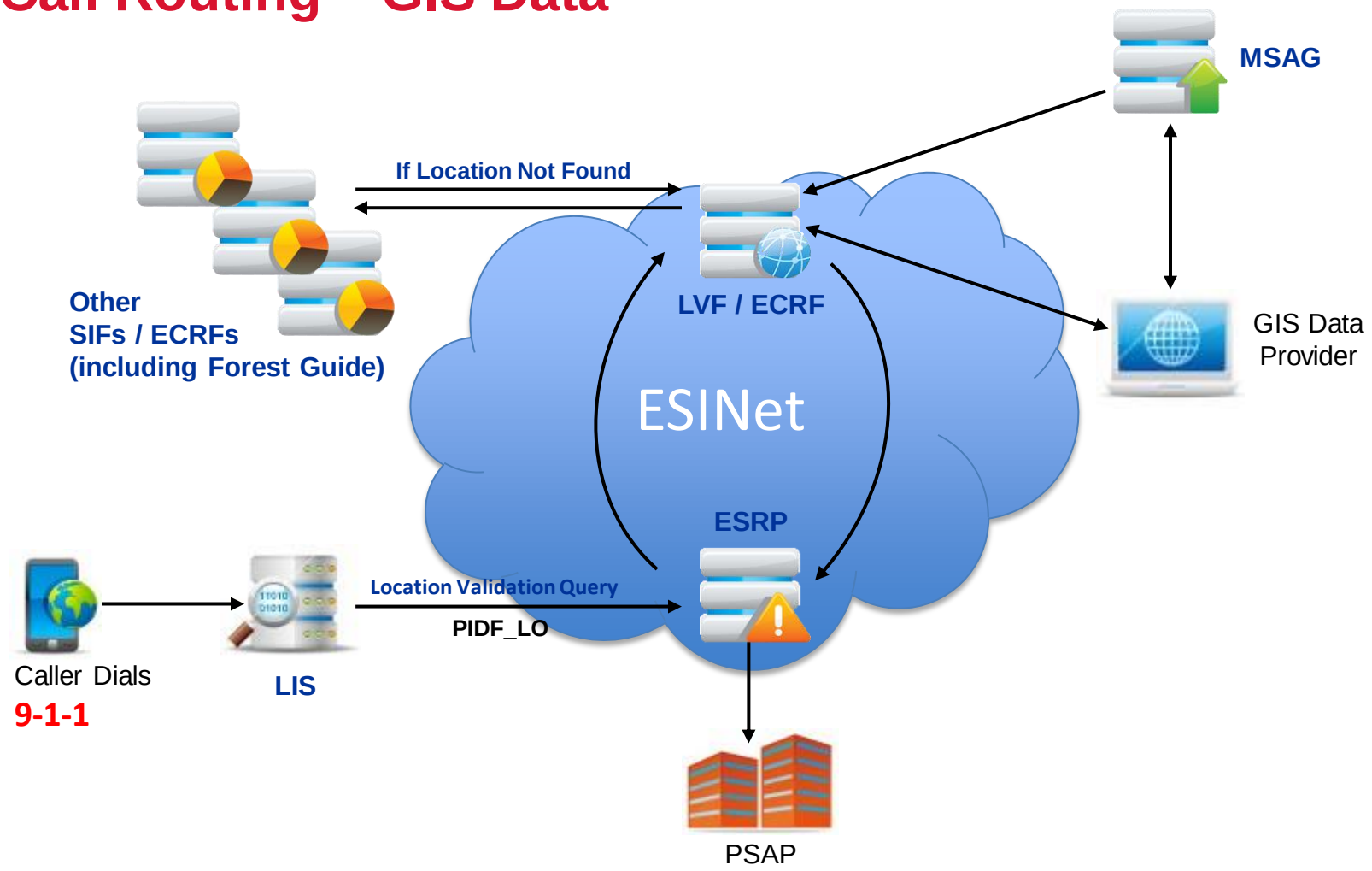
- When a standard or requirements document comes up for public review, provide comments.
- Expect the Forest Guide document next then ECRF / LVF and or Data Management for adoption.
- SSAP document planned for acceptance before the end of the year (hopefully).
- Expect the Data Model document for public review in the near future.
- NENA Development Conference (NDC) October 6th-8th, Orlando Florida (GIS & Location Track).
- An 'Issue Statement' was submitted to NENA for a GIS in 9-1-1 Guidebook.
- Join a workgroup(s) if you can to know what's coming, and have input on the future!

Quality Data. Quality Response.

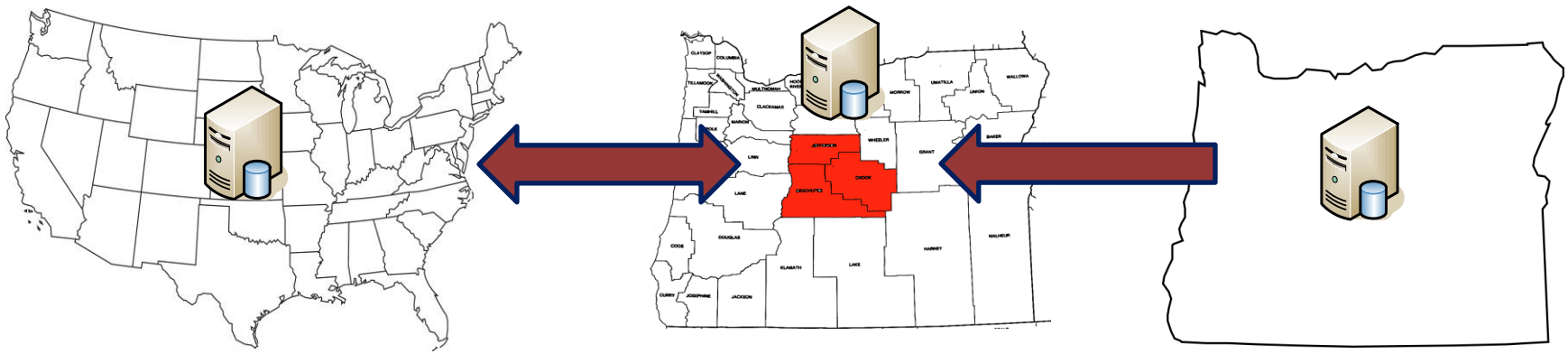
911 Datamaster

GIS Data: How it will (or should) work.

i3 Call Routing – GIS Data



Multiple Destinations for Data



Forest Guide	ECRF	SIF
National / International GIS Data Aggregation & Routing	Local Data Call Routing	Regional or State Aggregation, QA / QC & Distribution

Goals For NG9-1-1GIS Data (or what I should know)

- i3 replaces today's 'Selective Router', 'MSAG' and 'ALI' using GIS data to support both location validation and call routing (GIS becomes mission critical)
- GIS data must be an accurate representation of reality combining knowledge from MSAG and ideally USPS.
- GIS data must meet local QA / QC thresholds:
  - APs, RCLs and ESZs have matching 9-1-1 attributes
  - Street ranges, parity, etc. are congruent between MSAG and GIS.
  - Reconcile MSAG and GIS data to a match rate > 98%
- GIS data must meet QA / QC thresholds when aggregated with adjacent jurisdictions.
- GIS data updates will need to flow easily and in a timely manner into an LVF/ECRF.

Quality Data. Quality Response.

911 Datamaster

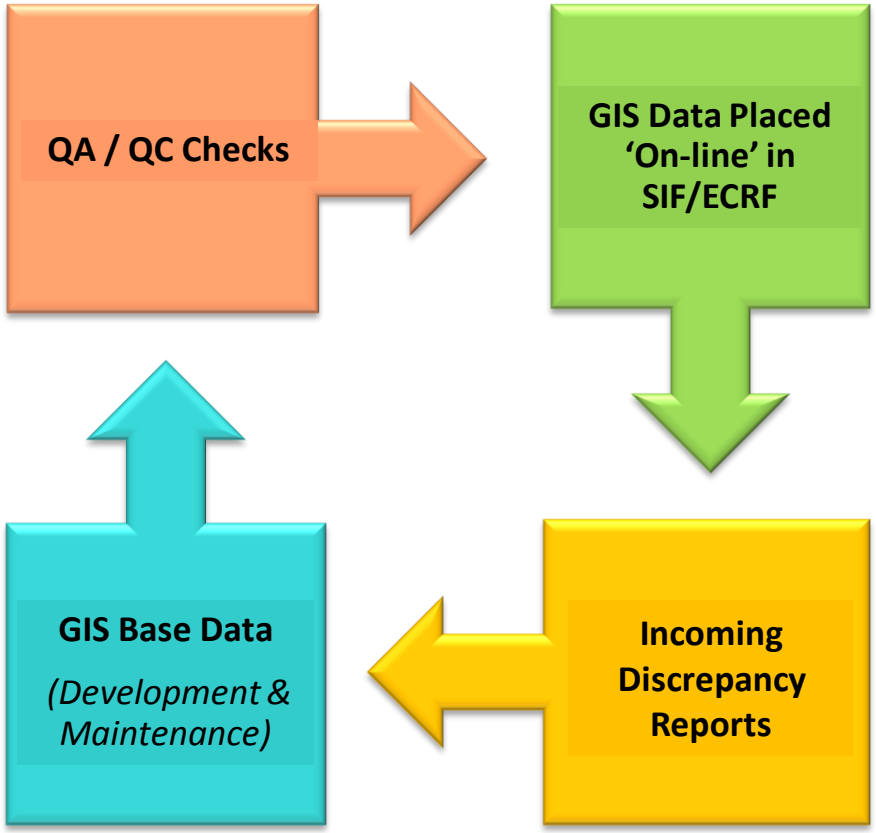
GIS QA / QC

Good GIS Data = Table-stakes for NG9-1-1

- In the past, good GIS data was a “nice to have” for 9-1-1 Authorities.
- For NG9-1-1, it is a baseline requirement.
- Most organizations do not have GIS data that meets the quality and content standards outlined by NENA. In some cases data is degrading.
- Attitude regarding data status should not be “Our data is good because so-and-so created it” but rather an objective assessment over subjective.
- More important/alarming is that many organizations do not have the resources and / or capacity to meet the GIS requirements for NG9-1-1
- Staffing & Training
  - Little to no time to review and update while still perform regular duties.
  - Needed expertise is dropping with turnover.
  - Too little or too much complexity in both procedures and software.

NG 9-1-1 GIS Data Development / Management Process

- GIS Data Collection and Maintenance Standards
- Information Document on GIS Database to MSAG & ALI Synchronization Process
- Upcoming Standards for NG9-1-1 GIS Data Model
- Upcoming Information Document for Development of Site/Structure Address Point GIS Data for 9-1-1
- Upcoming Standards for the Provisioning and Maintenance of GIS data to ECRF/LVF
- Upcoming Requirements for Next Generation 9-1-1 Data Management



Synchronizing GIS with MSAG/ALI

NENA Information Document for Synchronizing Geographic Information System databases with MSAG & ALI (pg.8 NENA 71-501):

- "…the synchronization process will never yield a 100 percent match rate."
- "It is recommended that a minimum match rate of 98% be set prior to using the GIS data…"
- "…should be part of an ongoing and continuous process to ensure that the databases remain current and synchronized."
- "Standardization and quality control processing must take place on the GIS street centerline data and the MSAG data prior to comparing the two data sets…"
- For GIS street centerlines in this process "Actual address ranges should be used".
- GIS street centerlines should contain all valid addressing information present in the MSAG.

Synchronizing GIS with MSAG/ALI

- Standardization of the GIS road centerline data and the MSAG data should incorporate the following (pg.9 of NENA 71-501):
  - N, S, E, W, NE, NW, SE, or SW as the only directionals used.
  - Directionals abbreviated when not part of the actual street name.
  - Punctuation should be avoided and special characters removed (ex. dashes).
  - Use only whole numbers in the house number fields.
  - Use complete spelling of the legal street name as assigned.
  - Spell out the complete MSAG and Postal Community name.
  - Standardize street name components according USPS Publication No. 28.
- Attribute fields should be fully parsed out per the NG9-1-1 GIS Data Model.

GIS Standardization Example

Prefix Directional	Street Name	Street Suffix	Post Directional
	North Elm	St	
N	Grand W Parkway		
	Barton Trail		
	Cana Road		
	Stockyard's	PKY	
	Mary's Place		S
	Market Plaza		
	M.L.K.	BV	
	W 9		
	Av J		
	St Albans	Ln	
	M. D. Anderson	Blvd	
E	R. Jones Road		

Before

Prefix Directional	Street Name	Street Suffix	Post Directional
N	Elm	St	
N	Grand West	Pkwy	
	Barton	Trl	
	Cana	Rd	
	Stockyards	Pkwy	
	Marys	Pl	S
	Market	Plz	
	M L K	Blvd	
W	9th		
	Avenue J		
	Saint Albans	Ln	
	M D Anderson	Blvd	
E	R Jones	Rd	

After

NG9-1-1 GIS Data Model Example

Site/Structure Address Field	XML Element	M/C/O	Data Example
Source of Data	**DataSource**	**M**	**Hulk County 9-1-1**
Date Updated	**LastUpdate**	**M**	**12/01/2012**
Effective Date	**EffectiveDate**	**M**	**01/01/2013**
Expiration Date	ExpirationDate	O	
Site _Unique_ID	**SiteUnqID**	**M**	**05673@hulk911.tx.us**
Country	**Country**	**M**	**US**
State	**A1**	**M**	**Texas**
County	A2	C	Hulk
Incorporated Municipality	**A3**	**M**	**West Lake Hollow**
Unincorporated Community	A4	C	
Address Number Prefix	HNP	O	
Address Number	HNO	C	105
Address Number Suffix	HNS	C	S
Street Name Pre-modifier	PRM	O	Old
Street Name Pre-directional	PRD	C	N
Street Name Pre-type	STP	O	
Street Name	RD	**C**	Franklin
Street Name Post Type	STS	C	St
Street Name Post Directional	POD	C	S
Street Name Post Modifier	POM	O	Bypass

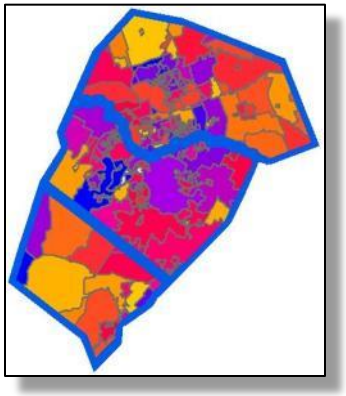
Site / Structure Address Point
(partial list)

NG9-1-1 GIS Data Model Example

Site/Structure Address Field	XML Element	M/C/O	Data Example
ESN	ESN	C	105
MSAG Community	MSAGCommunity	C	Hulk
Postal Community Name	PCN	C	West Lake Hollow
Postal Code	PC	C	75216
ZIP Plus 4	PC4	O	
Building	**BLD**	**O**	**A**
Floor	**FLR**	**O**	**2**
Unit	**UNIT**	**O**	**7**
Room	**ROOM**	**O**	**701**
Seat	**SEAT**	**O**	**2**
Additional Location	**LOC**	**O**	**On drive off main road**
Complete Landmark Name	LMK	O	
Milepost	Milepost	C	
Place Type	PLC	C	Business
Longitude	Long	O	-86.77791
Latitude	Lat	O	32.20912
Elevation	Elev	O	

Site / Structure Address Point
(partial list)

Polygon Problems To Be Checked For

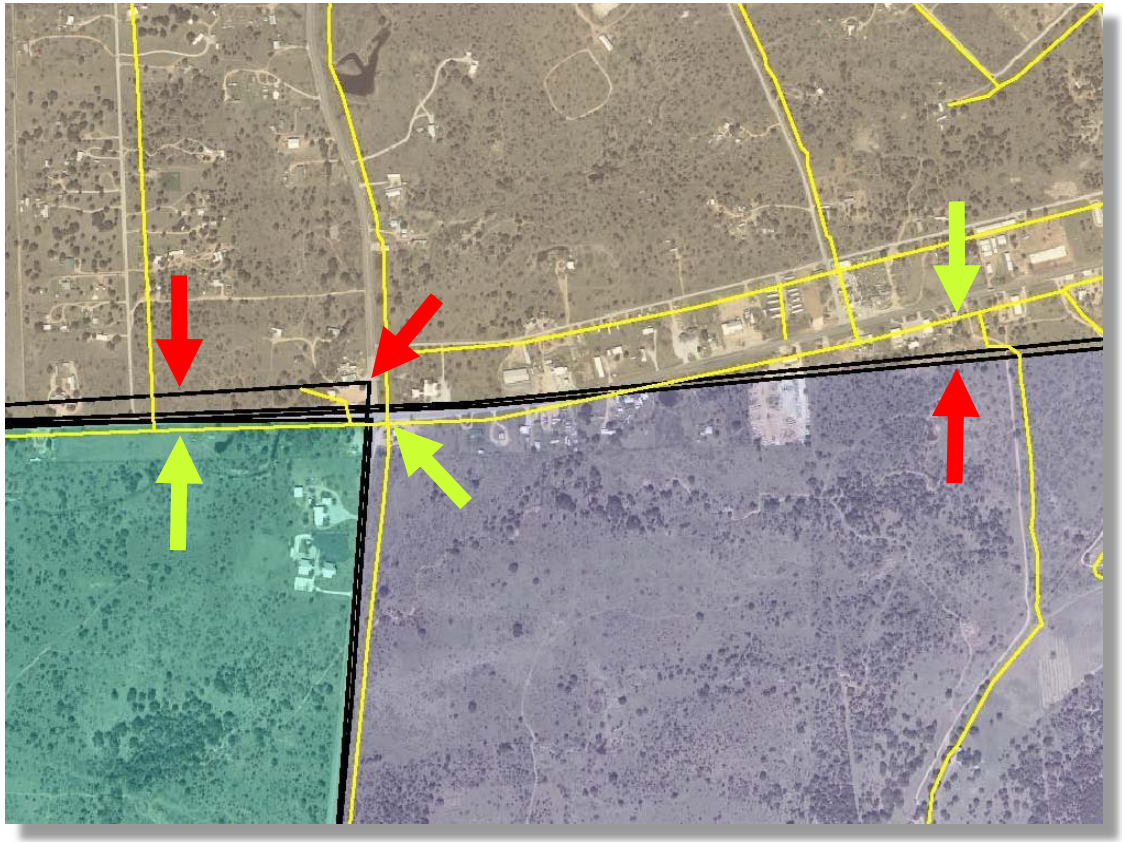


GIS Data Collection and Maintenance Standards (NENA 02-014)

On Emergency Service Zones (Section 4.3.4) check for:

- Relation check of ESZ, ESN, Emergency Service Agency (ESA)
- Remove empty (null / sliver) polygons
- ESZ, ESN info matches to MSAG / ALI
- Eliminate gap and overlapping polygons
- ESZ Boundaries should be joined to jurisdictional boundaries where appropriate (e.g. roads, rivers, municipality). All coincident boundaries should be exact (joined vertices to vertices

Typical Boundary Line Problems



- Inaccurate boundary lines may cause routing issues.
- Polygon boundaries should be a #1 priority for review / updating.

Sample LoST Response Using Expiration Date (RFC 5222)

```
<findServiceResponse>
  xmlns="urn:ietf:params:xml:ns:lost1"
  xmlns:p2="http://www.opengis.net/">
  <mapping
    expires="2013-12-31T012:59:00Z"
    lastUpdated="2012-01-15T09:15:23Z"
    source="authoritative.example"
    sourceId="cf19bbb038fb4ade95852795f045387d">
    <displayName xml:lang="en">
      Austin City Police Department
    </displayName>
    <service>urn:service:sos.police</service>
    <serviceBoundary profile="geodetic-2d">
      …
    </serviceBoundary>
    <uri>sip:apd@example.com</uri>
    <serviceNumber>911</serviceNumber>
  </mapping>
  <locationUsed id="DEF 215"/>
</findServiceResponse>
```

RCL Problems To Be Checked For

GIS Data Collection and Maintenance Standards (NENA 02-014)

On Road Centerlines (Sections 4.3.2, 4.3.3, 4.3.5) check for:

- Valid attribute values
- Duplicate line segment identification
- Route connectivity errors (Vital for network and routing analysis)
- Overlapping address ranges within the same ESN
- Duplicate road names in same town (MSAG Community)
- Road names in the MSAG / ALI should agree with the road names in GIS
- Line segments should be split on intersections, ESZ boundaries, and jurisdictional boundaries.
- Flow of the line direction should reflect the increasing address range.
- Invalid dangle nodes should be removed.

RCL Address Ranges And NG9-1-1

1098	1100	Main Street		1198	1200
1099	1101	PSAP 'A'	PSAP 'B'	1199	1201

Potential Address Ranges

(continuous, exhaustive, hypothetical, ordered, on the real)

This could make a big difference in an ECRF

geospatial call routing environment

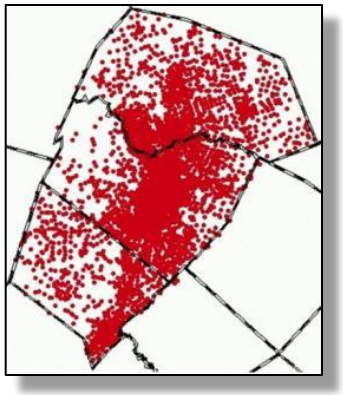
VS

Actual Address Ranges

1022	1100	Main Street		1102	1200
1023	1101	PSAP 'A'	PSAP 'B'	1103	1201

Where will '1103 Main Street' route?

AP Problems To Be Checked For

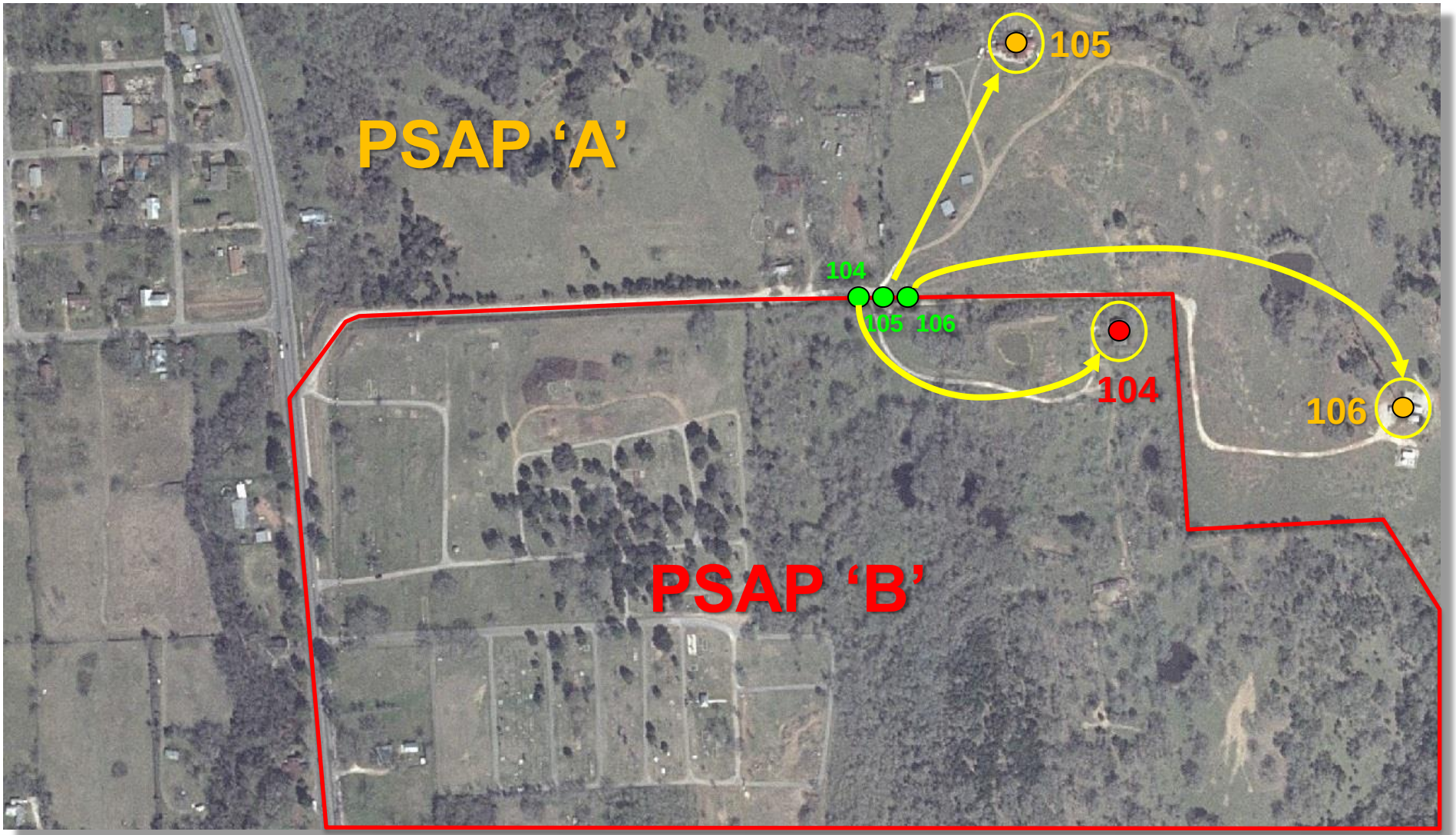


GIS Data Collection and Maintenance Standards (NENA 02-014)

On Sites (Section 4.3.1) check for:

- Valid attribute values
- Duplicate sites identification – sites with the same address
- Parity address check
- Site address matches to ALI Data Base

AP Locations and NG 9-1-1 Call Routing



The Need For Universal Unique IDs

Universal Unique ID's (UUID) must be included for all required GIS data elements in NG 9-1-1. (Standard for NG9-1-1 GIS Data Model - NENA 71-003, Section 3.4)

Format recommended in the GIS Data Model:

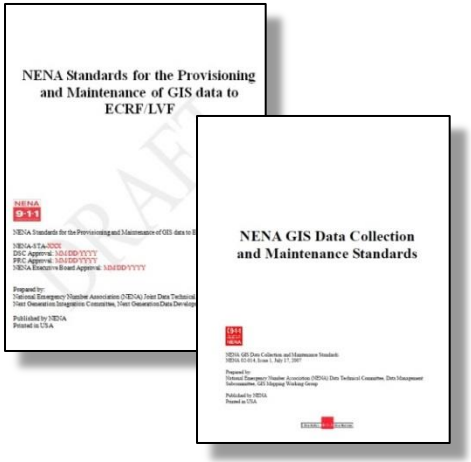
- Each data provisioning entity would follow a unique identifier for its domain (ex…**@MYCOUNTY.TX.US**).
- Data provisioning entities maintain **local Unique ID numbers** for all features in their GIS.
- A Universal Unique ID can be generated by taking local Unique ID numbers and concatenating to the end of each the providers domain.

Example: 9025719 + @MYCOUNTY.TX.US = 9025719@MYCOUNTY.TX.US

Accuracy of GIS Data

Upcoming 'Standards for the Provisioning and Maintenance of GIS data to ECRF / LVF' cites accuracy and precision requirements from the 'GIS Data Collection and Maintenance Standards' (NENA 02-014).

- GIS vector data should meet National Map Accuracy Standards at 1:5000 (section 2.1).
- GIS vector data sources accurate at 1:24,000 or better (section 2.2).
- GPS data collected with accuracy of 3 meters or better (section 2.2).
- Coordinate Reference Systems and datum for ECRF / LVF data.
  - WGS84 is required for all GIS information within the ECRF/LVF.
  - For 2-dimensional geometries, geodetic parameters required to follow EPSG:4326
  - (European Petroleum Survey Group).
  - For **3-dimensional geometries**, geodetic parameters required to follow EPSG:4979.



How Old is Too Old for Data in NG9-1-1?

- In the past, map displays got updated when they got updated.
  - Most times a manual process, somtimes automated, but always requiring user initiation.
  - Mapping systems got replaced once perception of map ‘inadequacy’ occurs.
  - If map data was insufficient, there was always the caller to ask.
- In the future it’s all on us! So what are the implications?
  - GIS must get updated quickly which could mean 5 days, 3 days or perhaps even less.
  - When mapping data fails, who fixes it and how is it replaced?
    - Time of day staffing (nights, weekends, holidays)
    - Data backups (last known ‘good version’, retrieval processes)
  - Are processes documented in all organizations for others to follow?
  - Expiration dates for data. Needed? Ramifications?

GIS Data Priorities

Prioritize building / upgrading data layers needed specifically for NG9-1-1

1. Polygon Boundaries
2. Road Centerlines
3. Address Points

Assess where each data layer stands

- Where are internal geographic data coverage gaps and overlaps?
- Where are gaps and overlaps compared to adjacent jurisdictions?
- What ‘required’ attribution is missing?
- What attribution present is incorrect?

You can project the time it will take to upgrade your NG 9-1-1 required data.

Quality Data. Quality Response.

911 Datamaster

Summation

Material Covered

- Transitioning from Traditional: ALI to LDB / LIS and MSAG to LVF / ECRF.
- The ‘Location Database’ and its centralized role in NG9-1-1.
- CIDB and the ‘Other’ Stuff – Supplemental Data.
- LVF / ECRF Functionality and Data.
- The SIF and the Forest Guide
- Bridging the gap to the network: ESRPs, BCFs and the rest.
- NG9-1-1 GIS Data: How it Will (or Should) Work.
- GIS Related NENA Standards and Where They Stand.
- GIS Data: Review, Update and Maintain.
- Who’s responsible for what.
- What you should consider as priorities going forward.

Final Thoughts

What we should keep in mind about NG9-1-1 data:

- It's an unattended system we are building here.
- Preparing and managing NG 9-1-1 GIS data is complicated and resource intensive.
- GIS data must be evaluated by thorough QA / QC processes before being used in a live NG9-1-1 call routing environment, as inaccurate or incomplete spatial data can result in incorrect or default call routing.
- Efficient research and timely data corrections are essential for NG9-1-1.
- Improvements in NG9-1-1 GIS data now will benefit all 9-1-1 GIS centric applications (PSAP map displays, CAD etc.).
- Good data review and maintenance practices will help mitigate some (hopefully most) problems that arise during transition.

Questions

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