ATIS-0500042

Conceptual Architecture Implementation Guidelines for ATIS-0700028

(Location Accuracy Improvements for Emergency Calls)

TECHNICAL REPORT

As a leading technology and solutions development organization, the Alliance for Telecommunications Industry Solutions (ATIS) brings together the top global ICT companies to advance the industry's most pressing business priorities. ATIS' nearly 200 member companies are currently working to address the All-IP transition, 5G, network functions virtualization, big data analytics, cloud services, device solutions, emergency services, M2M, cyber security, network evolution, quality of service, billing support, operations, and much more. These priorities follow a fast-track development lifecycle — from design and innovation through standards, specifications, requirements, business use cases, software toolkits, open source solutions, and interoperability testing.

ATIS is accredited by the American National Standards Institute (ANSI). The organization is the North American Organizational Partner for the 3rd Generation Partnership Project (3GPP), a founding Partner of the oneM2M global initiative, a member of the International Telecommunication Union (ITU), as well as a member of the Inter-American Telecommunication Commission (CITEL). For more information, visit www.atis.org.

ATIS-0500042, *Conceptual Architecture Implementation Guidelines for ATIS-0700028 (Location Accuracy Improvements for Emergency Calls)*

Published by

Alliance for Telecommunications Industry Solutions

1200 G Street, NW, Suite 500

Washington, DC 20005

ATIS-0500042

ATIS Technical Report on

Conceptual Architecture Implementation Guidelines for ATIS-0700028

(Location Accuracy Improvements for Emergency Calls)

Alliance for Telecommunications Industry Solutions

Approved January 13, 2020

Abstract

This Technical Report provides an overview of ATIS-0700028 and how it relates into the Public Safety environment. In particular it provides guidelines on additional location information that may be provided by the National Emergency Address Database (NEAD) for both the legacy emergency services network and for NG9-1-1.

Foreword

The Alliance for Telecommunications Industry Solutions (ATIS) serves the public through improved understanding between carriers, customers, and manufacturers. The ESIF Next Generation Emergency Services (NGES) Subcommittee coordinates emergency services needs and issues with and among SDOs and industry forum/committees, within and outside ATIS, and develops emergency services (such as E9-1-1) standards, and other documentation related to advanced (i.e., Next Generation) emergency services architectures, functions, and interfaces for communications networks.

The mandatory requirements are designated by the word *shall* and recommendations by the word *should*. Where both a mandatory requirement and a recommendation are specified for the same criterion, the recommendation represents a goal currently identifiable as having distinct compatibility or performance advantages. The word *may* denotes a optional capability that could augment the standard. The standard is fully functional without the incorporation of this optional capability.

Suggestions for improvement of this document are welcome. They should be sent to the Alliance for Telecommunications Industry Solutions, NGES, 1200 G Street NW, Suite 500, Washington, DC 20005.

At the time of consensus on this document, ESIF, which was responsible for its development, had the following leadership:

J. Green, ESIF Chair (Sprint)

R. Muscat, ESIF 1st Vice Chair, (Bexar Metro 911)

D. Morkunas, ESIF 2nd Vice Chair (Intrado)

C. Militeau, ESIF NGES Co-Chair (Intrado)

T. Reese, ESIF NGES Co-Chair (Ericsson)

The ESIF Next Generation Emergency Services Subcommittee was responsible for the development of this document.

Table of Contents

1 SCOPE, PURPOSE, & APPLICATION 1

1.1 SCOPE 1
1.2 PURPOSE 1
1.3 APPLICATION 1

2 REFERENCES 1

3 DEFINITIONS, ACRONYMS, & ABBREVIATIONS 2

3.1 DEFINITIONS 2
3.2 ACRONYMS & ABBREVIATIONS 3

4 INTRODUCTION 4

5 ATIS-0700028 ARCHITECTURAL OVERVIEW 5

5.1 SUPPORT FOR BLUETOOTH 6

6 ATIS-0700028 PROCEDURES AND DATA FLOWS 6

6.1 ACCESS POINT AND BLUETOOTH BEACON PROVISIONING METHODS 6
6.1.1 Access Point and Bluetooth Beacon Provision Method for ATIS-0700028.v1.1 7
6.1.2 Access Point and Bluetooth Beacon Provisioning Method for ATIS-0700028.v2.0 7
6.2 REAL-TIME ACQUISITION AND PROCESSING OF LOCATION INFORMATION 8
6.2.1 Real-Time Acquisitioning and Processing of Location Information for ATIS-0700028.v1.1 8
6.2.2 Real-Time Acquisitioning and Processing of ELS Information for ATIS-0700028.v2.0 10

7 CONSIDERATIONS FOR PUBLIC SAFETY 11

7.1 CONSIDERATIONS FOR A LEGACY EMERGENCY SERVICES NETWORK 11
7.2 CONSIDERATIONS FOR A NG9-1-1 EMERGENCY SERVICES NETWORK 13

Table of Figures

FIGURE 1 HIGH LEVEL NEAD SERVICE ARCHITECTURE FOR ATIS-0700028.V1.1 5
FIGURE 2 HIGH LEVEL NEAD SERVICE ARCHITECTURE INCLUDING EXTERNAL LOCATION SERVER FOR ATIS-0700028.V2.0 6
FIGURE 3 ATIS-0700028.V1.1 ACCESS POINT AND BLUETOOTH PROVISIONING 7
FIGURE 4 ACCESS POINT AND BLUETOOTH BEACON PROVISIONING METHODS FOR ELS FOR ATIS-0700028.V2.0 8
FIGURE 5 REAL-TIME ACQUISITION AND PROCESSING OF LOCATION 9
FIGURE 6 REAL-TIME ACQUISITION AND PROCESSING OF ELS LOCATION FOR ATIS-0700028.V2.0 10

Table of Tables

ATIS-0700028 TABLE 7-1 – POSITION SOURCE VALUES 12
ATIS-0700028 TABLE 7-2 – LS LOCATION METHOD TOKENS 14

ATIS Technical Report on –

Conceptual Architecture Overview for ATIS-0700028 (Location Accuracy Improvements for Emergency Calls)

1 Scope, Purpose, & Application

1.1 Scope

The scope of this Technical Report is to provide a high level overview of ATIS-0700028 version 1.1 [Ref 2] and version 2.0 [Ref 3] and highlight implications to Public Safety associated with the introduction of the National Emergency Address Database (NEAD) Platform and External Location Services (ELS).

1.2 Purpose

This document provides an overview of ATIS-0700028 and how it integrates into the Public Safety environment. In particular it provides guidelines on additional location information that may be provided by the NEAD and External Location Services (ELS) for both the legacy emergency services network and for NG9-1-1.

The following concepts are addressed:

- The concepts of adding Access Point and Bluetooth beacon location information into, or accessible by, the NEAD
- The concept of choosing a specific Access Point or Bluetooth beacon location to be provided toward the PSAP
- The Class of Service and/or Method Token implications
- The Location information and restrictions applicable to PSAPs supported by legacy emergency services networks
- The Location information that can be provided to a PSAP supported by an NG9-1-1 network

1.3 Application

This Technical Report is intended for wireless industry stakeholders and Public Safety to inform them on the technical capabilities of the NEAD Platform and the implications of additional location information that may be provided to the PSAP.

2 References

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below.

[Ref 1] FCC 07-114, *Federal Communications Commission Fourth Report and Order In the Matter of Wireless E911 Location Accuracy Requirements*.[1]

[Ref 2] ATIS-0700028.v1.1, ATIS Standard on Location Accuracy Improvements for Emergency Calls.[2]

[Ref 3] ATIS-0700028.v2.0, ATIS Standard on Location Accuracy Improvements for Emergency Calls.[2]

[Ref 4] ATIS/TIA J-STD-036-C-2, *Enhanced Wireless 9-1-1 Phase II*, July 2017. [2]

[Ref 5] Bluetooth Special Interest Group, *Bluetooth® Core Specification v4.2*, December 2014.[3]

[Ref 6] NENA 05-001, *NENA Standard for the Implementation of the Wireless Emergency Service Protocol E2 Interface*.[4]

[1] This document is available from the Federal Communications Commission at: < http://www.fcc.gov/ >.

[2] This document is available from the Alliance for Telecommunications Industry Solutions (ATIS) < https://www.atis.org/ >.

[3] This document is available from Bluetooth Special Interest Group at: < https://www.bluetooth.org/en-us/specification/adopted-specifications >.

[Ref 7] NENA STA-015.10-2018 (Originally 02-010), *NENA Standard Data Formats for E9 1 1 Data Exchange & GIS Mapping*.[4]

3 Definitions, Acronyms, & Abbreviations

For a list of common communications terms and definitions, please visit the *ATIS Telecom Glossary*, which is located at < http://www.atis.org/glossary >.

3.1 Definitions

- **Bluetooth Public Device Address (BT-PDA)** – Forty-eight (48) bit globally unique address used to identify a Bluetooth device.
- **Dispatchable Location** – Appendix D, (i) (1) iii of the FCC Report and Order [Ref 1] defines Dispatchable Location as follows:

  Dispatchable location: A location delivered to the PSAP by the CMRS provider with a 911 call that consists of the street address of the calling party, plus additional information such as suite, apartment or similar information necessary to adequately identify the location of the calling party. The street address of the calling party must be validated and, to the extent possible, corroborated against other location information prior to delivery of dispatchable location information by the CMRS provider to the PSAP.
- **Emergency Services (ES) Network** – ES Network signifies the NENA i3 ESInet and associated functional elements or the legacy Selective Router and ALI.
- **External Location Services** – External Location Services allow the NEAD Platform to retrieve the Access Point or Bluetooth beacon location information from an external source. Address information may be contained within an Enterprise or another source. For these Access Points or Bluetooth beacons, when the Serving Core Network queries the NEAD, the NEAD will query the External Location Server (ELS) and return the acquired location to the Serving Core Network.
- **Geocoding Process** – The geocoding process is the process used by the NEAM to convert a street address to geographic coordinates, and may or may not result in an indication of the geocoded location accuracy.
- **Heightened Location Accuracy** – A specific form of location according to FCC Report and Order [Ref 1] either a Dispatchable location or a position estimate accurate to within 50 m (horizontal).
- **Heightened Location Accuracy Technologies** – Paragraph 25 of the FCC Report and Order [Ref 1] refers to the definition of Heightened Location Accuracy Technologies presented in the Roadmap:

  25. As originally proposed, the Roadmap contained the following horizontal location accuracy performance benchmarks:

  … "Heightened location accuracy technologies" consist of: (1) satellite-based (A-GNSS) location, (2) dispatchable location, or (3) "any other technology or hybrid of technologies capable of location accuracy performance of 50 meters." …
- **Indoor Location** – A type of location information that means that the caller's device is within a structure that may be represented by a home, apartment, high-rise, enterprise, etc. Indoor location may be represented as a Dispatchable Location as defined above. Indoor location may also be solely represented by a geodetic location that includes the latitude and longitude and may potentially include vertical location information (e.g., z-axis).
- **Media Access Control (MAC) Address** – Forty-eight (48) bit globally unique address used to identify a Wi-Fi Access Point.
- **National Emergency Address Database (NEAD)** – Appendix D, (i) (1) iii of the FCC Report and Order [Ref 1] defines the NEAD (pronounced nee-ad) as follows.

[4] This document is available from the National Emergency Number Association (NENA) at < http://www.nena.org >.

National Emergency Address Database (NEAD). A database that utilizes MAC address information to identify a dispatchable location for nearby wireless devices within the CMRS provider's coverage footprint.

This standard also supports the use of BT-PDA to identify the dispatchable location for nearby Bluetooth beacons.

- **National Emergency Address Manager (NEAM)** – The NEAM is the administrative platform that receives Access Point or Bluetooth location information, geocodes it, validates it and pushes it to the NEAD.
- **NEAD Platform** – NEAD Platform is the term used to denote the complex of the NEAD and NEAM.
- **Reference Point** – A Wi-Fi access point whose MAC address or a Bluetooth device BT-PDA is detectable by the user's end device during an emergency call. A Reference Point identifier may be associated with a candidate Dispatchable Location in the NEAD. In ATIS-0700028, Reference Point is also used to indicate a Reference Point identifier.
- **Uncompensated Barometric Pressure (UBP)** - Barometric pressure (also known as atmospheric pressure) is the force exerted by the atmosphere at a given point. UBP means that the pressure has not been changed or modified from the source. For use by Public Safety it is defined as an integer between 30,000 and 115,000 in units of Pascals.
- **Vertical Location Information** – Appendix D, (2) ii of the FCC Report and Order [Ref 1] defines vertical location as one of 1) the floor component of a Dispatchable Location, 2) barometric pressure, or 3) z-axis methods to be defined through the evaluation of technologies in the test bed.

3.2 Acronyms & Abbreviations

3GPP	Third Generation Partnership Project
ALI	Automatic Location Identification
ANI	Automatic Number Identification
AP	Access Point
APCO	Association of Public Safety Communications Officials
ATIS	Alliance for Telecommunications Industry Solutions
BLE	Bluetooth Low Energy
BT	Bluetooth®
BT-PDA	Bluetooth – Public Device Address
CMA	Cellular Market Area
CMRS	Commercial Mobile Radio Service
CSCF	Call Session Control Function
DL	Dispatchable Location
E-CSCF	Emergency CSCF
ELC	External Location Controller
ELS	External Location Server
ES	Emergency Services

ESInet	Emergency Services IP network
E-SMLC	Enhanced Serving Mobile Location Center
ESRD	Emergency Service Routing Digits
ESRK	Emergency Service Routing Key
ESRP	Emergency Services Routing Proxy
FIPS	Federal Information Processing Standard
GL	Geodetic Location
GMLC	Gateway Mobile Location Center
HALI	Heightened Accuracy Location Information
HELD	HTTP-Enabled Location Delivery
HTTP	HyperText Transfer Protocol
IMS	IP Multimedia Subsystem
LCS	Location Services
LPG	Legacy PSAP Gateway
LRF	Location Retrieval Function
MAC	Media Access Control
LTE	Long Term Evolution
MGCF	Media Gateway Control Function
NEAD	National Emergency Address Database
NEAM	National Emergency Address Manager
NENA	National Emergency Number Association
PIDF-LO	Presence Information Data Format – Location Object
PSAP	Public Safety Answering Point
QoS	Quality of Service
RDF	Routing Determination Function
RP	Reference Point
SMLC	Serving Mobile Location Center
UBP	Uncompensated Barometric Pressure
UE	User Equipment
URI	Uniform Resource Identifier

4 Introduction

A voluntary agreement for improving indoors location accuracy for emergency calls was developed and signed on November 14, 2014, by APCO, NENA, AT&T, Sprint, T-Mobile, and Verizon Wireless. This voluntary agreement

included a roadmap for technology changes that was submitted to the FCC in response to an FCC initiative (proceeding 07-114 [Ref 1]) to provide a number of improvements to indoors emergency location capabilities including providing a Dispatchable Location for emergency calls to PSAPs.

ATIS's Emergency Location Taskforce (ELOC) developed the ATIS-0700028 standard to support the commitments defined in the roadmap. Specifically it developed requirements, procedures and protocols that specified how the NEAM would accept location information from what was called External Data Sources, validate that location, geocode it and push it to the NEAD. In addition it defined how External Location Services could provision information in the NEAM that would allow the NEAD to query these services for location information. The NEAD is a real-time database that is queried by elements in the CMRS Serving Core Network during call setup. The NEAD returns address information associated with the Access Points or Bluetooth beacons visible to the user's mobile device. The CMRS Serving Core Network then choses the most appropriate location provided by the NEAD and forwards it, along with the geodetic location it acquired, toward the PSAP.

5 ATIS-0700028 Architectural Overview

ATIS-0700028 has had two major releases. In ATIS-0700028.v1.1 [Ref 2] (Figure 1), Access Point and Bluetooth location information were provisioned directly in the NEAD. In ATIS-0700028.v2.0 [Ref 3] the (Figure 2), concepts of version 1.1 [Ref 2] were extended to allow the NEAD to query External Location Services (e.g. enterprises location servers) that may host Access Point or Bluetooth beacon location information.

In ATIS-0700028.v1.1 [Ref 2] (Figure 1) address information from External Data Sources[5] is sent to the NEAM (via the Np interface) and the NEAM geocodes, validates and pushes the location to the NEAD (via the Nm interface). During call set up the Serving Core Network queries the NEAD (via the Nq interface) with MAC Addresses or Bluetooth Public Device Addresses (BT-PDA) (collective called Reference Identifiers), and the NEAD returns location information (civic address and geocoded location) for all Reference Identifiers provisioned in the NEAD. The Serving Core Network may then select the most appropriate address provided by the NEAD and forward it, along with the geodetic location it acquired, toward the PSAP.

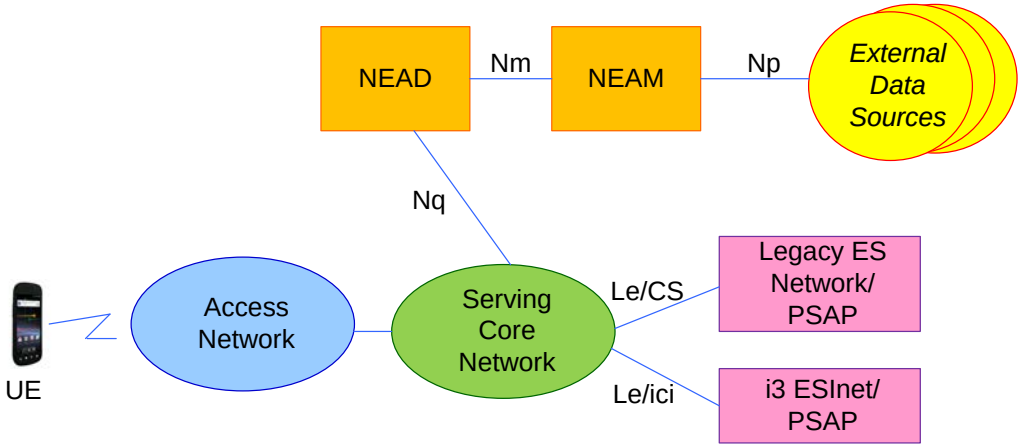

Figure 1 High Level NEAD Service Architecture for ATIS-0700028.v1.1

ATIS-0700028.v2.0 [Ref 3] (Figure 2) extended the concepts of version 1.1 [Ref 2] to include an interface to External Location Services that allows retrieving UE location based on Access Points or Bluetooth beacons managed and hosted by an external service on behalf of one or more enterprises. In support of External Location Services, the ELS hosts the location information of the Access Point or Bluetooth beacon as opposed to those being resident in the NEAD.

[5] External Data Sources may correspond to CMRS providers, users, or organizations that own or operate Wi-Fi Access Points or Bluetooth beacons.

The ELS provisions Reference Identifier and the URL of the ELS in the NEAM (via the Np' interface). (Therefore location information is not provisioned in the NEAD.) A Cellular Market Area (CMA) identifier is also supplied over the Np' designating the general geographic area in which the associated Reference Identifier is located. The CMA identifier is a Federal Information Processing Standard (FIPS) county code value. The NEAM stores this Reference Identifier and URL relationship in its database and pushes the Reference Identifier and the URL to the NEAD (via the Nm interface). (similar to version 1.1 [Ref 2]).

During call set up The CMRS Serving Core Network queries the NEAD (via the Nq interface) with the Reference Identifiers and External Location Services specific parameters. The NEAD correlates the parameters received with the URL provisioned. Then, the NEAD queries the ELS (via the Na interface). The ELS returns location information in the form of a civic address (candidate dispatchable address) including sub-address information, if available, along with geocoded position information back to the NEAD. And the NEAD returns these to the Serving Core Network.

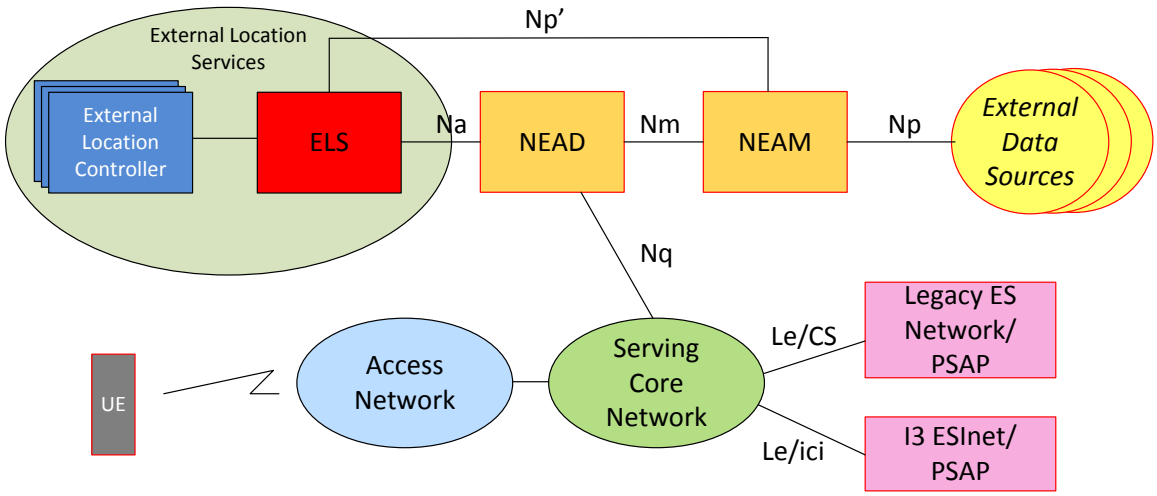

Figure 2 High Level NEAD Service Architecture Including External Location Server for ATIS-0700028.v2.0

5.1 Support for Bluetooth

According to the Bluetooth Core Specification [Ref 5] Vol 6, Part B, Section 1.3:

> *Devices are identified using a device address. Device addresses may be either a public device address or a random device address. A public device address and a random device address are both 48 bits in length.*

Refer to the advertising channel PDU header as specified in [Ref 5] Vol 6, Part B, Section 2.3, Figure 2.3. When the field TxAdd is set to zero, the device address in the advertising PDU is the public address (IEEE-assigned MAC address); when it is set to one, it is a random address (static, non-resolvable private, or resolvable private address). For beacons, the advertiser's address should always be a public address (TxAdd = 0).

In Bluetooth Low Energy (BLE), the total length of the device address is considered 49 bits because one of the bits that describes the type of the address is located within the PDU header as described above (separate from the device address).

In ATIS-0700028 only public device addresses are considered which require 48 bits.

6 ATIS-0700028 Procedures and Data Flows

This section discusses procedures and data flows for the provisioning of Access Point and Bluetooth beacon location information and for acquiring that information in real time to be forwarded to the PSAP.

6.1 Access Point and Bluetooth Beacon Provisioning Methods

For ATIS-0700028.v1.1 [Ref 2] the location information for Access Points and Bluetooth beacons is provisioned directly into the NEAM and the Reference Identifier and associated address are pushed to the NEAD. For ATIS-0700028.v2.0 [Ref 3] the actual location information of the Access Point or Bluetooth beacon resides in the

External Location Services and what is passed to the NEAM is information that will allow the NEAD to query the ELS. Therefore the NEAM pushes the Reference ID and ELS URI to the NEAD to allow the NEAD to query External Location Services during call time.

6.1.1 Access Point and Bluetooth Beacon Provision Method for ATIS-0700028.v1.1

When an External Data Source sends MAC Address or BT-PDA along with location information to the NEAM the NEAM will geocode it, validate that location and push the information to the NEAD. If the location does not validate, the NEAD Platform provider may perform data error correction or an invalid response is sent back to the External Data Source. In the latter case it is the responsibility of the operator of the External Data Source to correct the error.

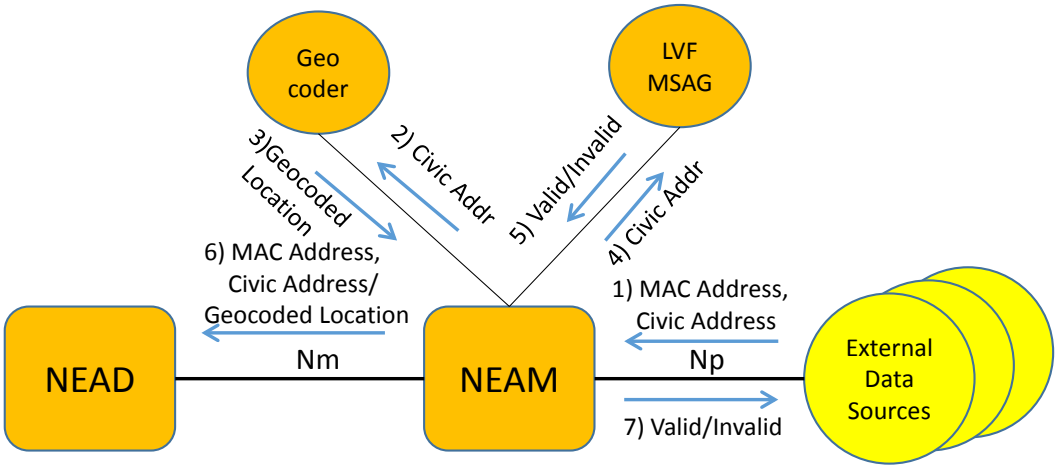

Figure 3 ATIS-0700028.v1.1 Access Point and Bluetooth Provisioning

1) External Data Source sends MAC Address[6] and civic address to the NEAM. Multiple MAC Addresses and civic addresses may be sent in a single request.
2) The NEAM sends a request to geocode the civic address.
3) The Geocoder returns the geocoded address.
4) The NEAM sends a request to validate the address.
5) When the location validation is performed either a response that the location is valid is returned or an invalid response is returned. If not valid, jump to Step 7 and return an invalid response.
6) The Reference Identifier, the address and the geocoded location is pushed to NEAD.
7) The response is returned to the External Data Sources

6.1.2 Access Point and Bluetooth Beacon Provisioning Method for ATIS-0700028.v2.0

ATIS-0700028.v2.0 [Ref 3] extended the concepts of ATIS-0700028.v1.1 [Ref 2] in that it allowed for Access Point or Bluetooth beacon location information to reside within an external database from the NEAD. So instead of an External Data Source sending a MAC Address and location information to the NEAM, the operator of the External Location Services sends appropriate information to the NEAM that will allow the NEAD to query the ELS for location. The ELS sends the Reference Identifier (Ref ID), the CMA and the ELS URL in the request to the NEAM. Then the NEAM pushes the Reference Identifier and the ELS URL to the NEAD. Note in this scenario it is up to the operator of the External Location Services to validate the address.

[6] For simplicity in the diagrams MAC Address is used. Bluetooth BT-PDA is also applicable.

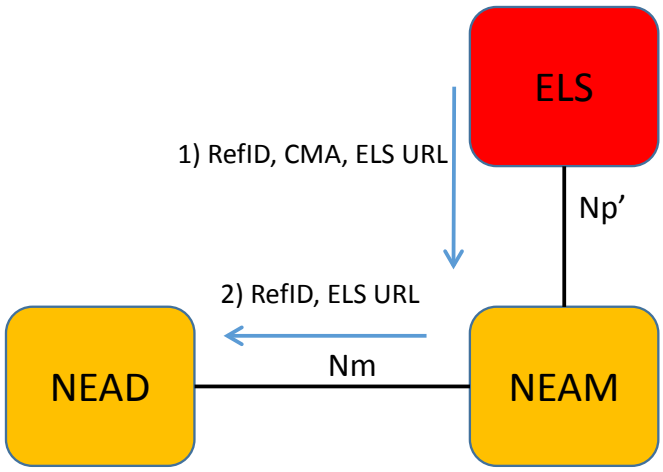

Figure 4 Access Point and Bluetooth Beacon Provisioning Methods for ELS for ATIS-0700028.v2.0

1) The ELS sends the Reference Identifier (Ref ID) (a MAC Address or Bluetooth BT-PDA), the CMA and the ELS URL to the NEAM
2) NEAM sends the Ref ID and ELS URL to the NEAD.

6.2 Real-Time Acquisition and Processing of Location Information

When the emergency call is initiated the Serving Core Network begins the process of location acquisition. It will perform the normal process of determining the geodetic location of the User Equipment, and in parallel, query the NEAD with the MAC Addresses visible to the UE. The Serving Core Network may use criteria (e.g., signal strength) to limit the number of access points it sends to the NEAD. For ATIS-0700028.v1.1 [Ref 2] the NEAD will return the address and geocoded location for all of the Access Points and Bluetooth beacons that are provisioned in the NEAD. For ATIS-0700028.v2.0 [Ref 3] the NEAD will query the ELS and the ELS will return the address and geocoded location. The NEAD will return these to the Serving Core Network. The Serving Core Network may select one of the addresses returned by the NEAD using a selection criteria (e.g. serving Access Point). The NEAD provided location is then combined with the geodetic location acquired and cached in anticipation of a query from the PSAP.

6.2.1 Real-Time Acquisitioning and Processing of Location Information for ATIS-0700028.v1.1

During call set up the Serving Core Network queries the NEAD with all (or a subset) of the MAC Addresses and Bluetooth beacon BT-PDA visible to the User Equipment. The NEAD will return the address information and the geocoded location of those provisioned in the NEAD. The Serving Core Network may choose the most appropriate address returned by the NEAD and combine it with the geodetic location it acquired. For legacy emergency service networks the Serving Core Network will select an ESRK and deliver the call to the Selective Router. Once the call in delivered to the PSAP the PSAP may query the Serving Core Network through the ALI. The geodetic location along with the NEAD provided address will be returned. For NG9-1-1 the Serving Core Network will create a location URI that will be passed to the NENA i3 ESInet. This process is called Location by Reference (LbyR). Then the ESRP may query for routing location and the PSAP may query for dispatch location.

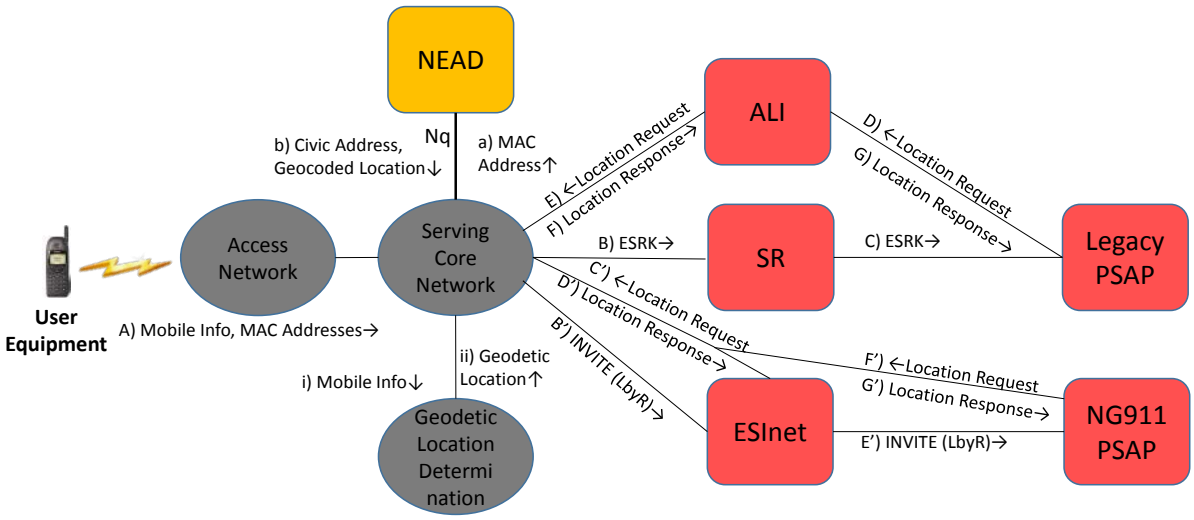

Figure 5 Real-Time Acquisition and Processing of Location

Steps as shown in Figure 5.

A) A 9-1-1 call is initiated and mobile information and the Access Point MAC Addresses acquired from the UE are sent to the Serving Core Network

When the Serving Core Network receives the call request, in parallel, it queries the NEAD for Access Point location information, performs procedures to acquire the geodetic location and routes the call toward the emergency services network.

a) The Serving Core Network queries the NEAD with all (or a subset) of Access Point MAC Addresses visible to User Equipment (UE).

b) The NEAD returns the address and geocoded locations provisioned in the NEAD.

i. The Serving Core Network provides mobile info to the Location Determination function.

ii. The Location Determination function returns the geodetic location of the User Equipment (UE).

Delivering an emergency call to a legacy emergency services network.

B) The Serving Core Network selects an ESRK and forwards the call to the Selective Router.

C) The Selective Router forwards the call to the PSAP.

D) The PSAP queries the ALI for location information using the ESRK.

E) The ALI queries the Serving Core Network for Location using the ESRK.

F) The Serving Core Network returns the address derived from the NEAD with the appropriate Position Source and the geodetic location to the ALI.

G) The ALI returns the location information to the PSAP with the associated Class of Service.

Delivering an emergency call to an i3 ESInet.

B') The Serving Core Network selects a location reference (Location by Reference [LbyR]) and forwards the call to the ESInet.

C') The ESRP in the ESInet (not shown) queries the Serving Core Network for a routing location using the location reference.

D') Depending upon the timing of the location acquisition process, the Serving Core Network may return a location associated with a cell site or the location of the User Equipment.

E') The ESRP uses the location to determine the appropriate PSAP and forwards the request to the NG9-1-1 PSAP.

F') The PSAP queries the Serving Core Network for a dispatch location using the location reference.

G') The Serving Core Network returns the address from the NEAD with the appropriate Method Token and a geodetic location.

6.2.2 Real-Time Acquisitioning and Processing of ELS Information for ATIS-0700028.v2.0

During call set up the Serving Core Network queries the NEAD with all (or a subset) of the MAC Addresses and Bluetooth BT-PDA visible to the User Equipment, and the MAC address of the User Equipment. The NEAD will query the ELS to obtain the location residing within the ELS. The ELS will return the civic address and geocoded location and the NEAD will return information to the Serving Core Network. The Serving Core Network may choose the most appropriate location returned by the NEAD and combine it with the geodetic location it acquired. For legacy emergency service networks the Serving Core Network will select an ESRK and deliver the call to the Selective Router. Once the call in delivered to the PSAP the PSAP may query the Serving Core Network through the ALI. The geodetic location along with the NEAD provided civic address will be returned. For NG9-1-1 the Serving Core Network will create a location URI that will be passed to the NENA i3 ESInet. Then the ESRP may query for routing location and the PSAP may query for dispatch location.

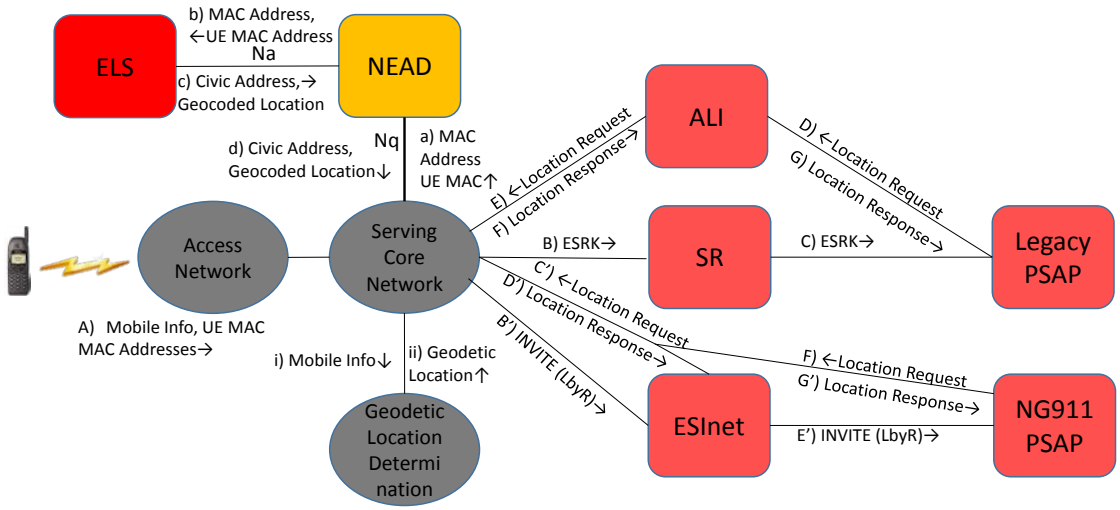

Figure 6 Real-Time Acquisition and Processing of ELS Location for ATIS-0700028.v2.0

Steps as shown in Figure 6.

A) A 9-1-1 call is initiated and mobile information and Access Point MAC Addresses acquired from the UE are sent to the Serving Core Network

When the Serving Core Network receives the call request it, in parallel, queries the NEAD for Access Point location information (and the NEAD queries the ELS), performs procedures to acquire the geodetic location and routes the call toward the emergency services network.

a) The Serving Core Network queries the NEAD with all (or a subset) of Access Point MAC Addresses visible to UE and the UE MAC Address.

b) The NEAD queries the ELS.

c) The ELS returns the civic address and geocoded location.

d) The NEAD returns the civic addresses and geocoded locations to the Serving Core Network.

i. The Serving Core Network provides mobile info to the Location Determination function.

ii. The Location Determination function returns the geodetic location of the User Equipment.

Delivering an emergency call to a legacy emergency services network.

B) The Serving Core Network selects an ESRK and forwards the call to the Selective Router.

C) The Selective Router forwards the call to the PSAP.

D) The PSAP queries the ALI for location information using the ESRK.

E) The ALI queries the Serving Core Network for Location using the ESRK.

F) The Serving Core Network returns the address derived from the NEAD with the appropriate Position Source and the geodetic location to the ALI.

G) The ALI returns the location information to the PSAP with the associated Class of Service.

Delivering an emergency call to an i3 ESInet.

B') The Serving Core Network selects a location reference (Location by Reference [LbyR]) and forwards the call to the ESInet.

C') The ESRP in the ESInet (not shown) queries the Serving Core Network for a routing location using the location reference.

D') Depending upon the timing of the location acquisition process, the Serving Core Network may return a location associated with a cell site or the location of the User Equipment.

E') The ESRP uses the location to determine the appropriate PSAP and forwards the request to the NG9-1-1 PSAP.

F') The PSAP queries the Serving Core Network for a dispatchable location using the location reference.

G') The Serving Core Network returns the address from the obtained from the ELS with the appropriate Method Token and a geodetic location.

7 Considerations for Public Safety

In general, the PSAP will obtain, in the response to its query, the address obtained from either the NEAD or the ELS, and the geodetic location of the User Equipment. Depending upon the type of emergency services network (legacy or NG9-1-1) there are certain aspects that need to be considered.

7.1 Considerations for a Legacy Emergency Services Network

When a 9-1-1 call is delivered to a legacy PSAP it will query the ALI for location using the ESRK that it received. In turn the ALI will query the Serving Core Network (i.e. the GMLC) with the ESRK. The GMLC will map the address and geodetic location to the E2 Emergency Position Request response message (esposreq) and pass it toward the regional ALI. The esposreq is defined in J-STD-036-C [Ref 4] and augmented in NENA-05-001 [Ref 6]. NENA extended the esposreq message to provide address information by defining address elements within the Location Description field of the esposreq. The elements defined in NENA-05-001 [Ref 6] are somewhat limited and the regional ALI must map those elements into the legacy PSAP format to be displayed at the PSAP.

ATIS-0700028.v1.1 [Ref 2] extended the elements that were defined in NENA-05-001 [Ref 6] to include sub-address elements that may be provided by the NEAD or the ELS. The priority (left to right) of mapping XML elements to the Location Description field in the E2 Location Description parameter is as follows:

BLD**|**FLR**|**UNIT**|**ROOM**|**SEAT**|**MP**|**LOC**|**LMK (or LMKP) **|**PLC|UBP

BLD – Building

FLR – Floor

UNIT – Unit[7]

ROOM – Room

SEAT – Seat

MP – Mile Post

LOC – Free format location

LMK (or LMKP) – Landmark

PLC – Place Type

UBP – Uncompensated Barometric Pressure

If present, the Place Type element will consist of a three-character notation, as described in Table 7-8 of ATIS-0700028. The Place Type values are summarized below:

RSS – Single Family Residential – Single story

RMS – Single Family Residential – Multi-story

MTS – Multi-Tenant Residential – Single story

MTM – Multi-Tenant Residential – Multi-story

CMS – Commercial – Single story

CMM – Commercial – Multi-story

MUM – Multi-Use – Multi-story (building with both commercial & residential occupants)

MUS – Multi-Use – Single story (building with both commercial & residential occupants)

If the mapping of XML elements to the E2 elements exceeds the E2 element length, the GMLC will truncate the string from right to left (left justified). If elements received in the E2 response are longer than can be utilized in the ALI server, the ALI will truncate the string from right to left (left justified). For example if the PSAP display only supports 20 characters in the Location field, the string may be truncated if the address string is longer than 20 characters. When truncation is applied it will apply to the entire element; an element should not be partially presented.

If the GMLC receives an address, and potentially sub-address elements, it will map the appropriate location Method Token it received to a Position Source. Three new Position Source values have been defined as shown in the table below.

ATIS-0700028 Table 7-1 – Position Source Values

55	Class of Service – WCVC representing an E9-1-1 civic location.
56	Class of Service – WDL1 representing an E9-1-1 medium -level quality dispatchable civic location.
57	Class of Service – WDL2 representing an E9-1-1 highest level quality dispatchable civic location.

The GMLC will map the location Method Token of NEAD-CVC and ELS-CVC to Position Source 55, location method token NEAD-DL1 and ELS-DL1 to Position Source 56, and location method token of NEAD-DL2 and ELS-DL2 to Position Source 57.

[7] The UNIT element may contain a value of the form “Apartment 12” or “Apt 12”.

The ALI will map these Position Sources to the appropriate Class of Service (WCVC, WDL1 or WDL2) as specified in NENA STA-015.10-2018 (Originally 02-010) [Ref 7] where those Classes of Service have been enabled in the ALI.

Where a civic address is provided in addition to a geodetic location, a legacy PSAP may need to decide whether to map based on the civic address or geodetic location. Where a PSAP receives a civic address that does not map correctly it will use standard operating procedures to resolve it. In some cases, the mapping display is triggered by the value of the Class of Service. It is important to ensure that the additional Class of Service values identified above are properly configured to facilitate the accurate mapping of these values.

ALI systems need to be capable of receiving Uncompensated Barometric Pressure (UBP) via the E2 interface (in the 60-character location [LOC] field), and ensuring that the information can be properly displayed on the ANI/ALI screen, when received. In addition, when available, NEAD derived location information, should be prioritized and displayed in accordance with PSAP requirements. Coordination with CPE, ALI, and service providers will be needed to properly configure PSAP systems to receive and display enhanced location, including data that carriers derive from the NEAD.

Before the rollout of the service, functional testing should be performed to ensure that all enhanced location data is received and displayed properly. Training of 9-1-1 Operations and PSAP personnel related to the receipt and processing of enhanced location is also required.

7.2 Considerations for a NG9-1-1 Emergency Services Network

When the NG9-1-1 PSAP queries the Serving Core Network it may receive a PIDF-LO that contains both a civic address and a geodetic location. The civic address may be that of an Access Point or Bluetooth beacon provisioned in the NEAD or obtain from the ELS, potentially including sub-address elements.

Table 7-7 in ATIS-0700028 lists the optional sub-address elements that may be provided in PIDF-LO. They are as follows:

Attribute	Description	Example
Building[8]	One among a group of buildings that have the same address number and complete street name.	"Building A" in 456 Oak Street, Building A, Apartment 206.
Additional Location[9] Information	Zone within a building (NW, SW, NE, SE) <=50 Meters	Zone=NW
Floor[10]	A floor, story, or level within a building.	“5th Floor” in 800 Jefferson Street, 5th Floor.
Unit[11]	A group or suite of rooms within a building that are under common ownership or tenancy, typically having a common primary entrance.	“Apartment 12” in 422 Via Casitas, Apartment 12.
Room[12]	A single room within a building.	“Room 137” in 123 Main Street, Room 137.
Seat[13]	A place where a person might sit within a building.	“Cubicle 23” in 2500 Seventh Street, Room 105, Cubicle 23.

[8] PIDF-LO BLD, Note since the Nq interface returns candidate Dispatchable Location and geographic information, in the format of PIDF-LO, the attributes in this table closely align with the NENA defined CLDXF PIDF-LO element profile.

[9] PIDF-LO LOC

[10] PIDF-LO FLR

[11] PIDF-LO UNIT

[12] PIDF-LO ROOM

[13] PIDF-LO SEAT

Attribute	Description	Example
Place Type[14]**	The type of feature identified by the address.	RSS (*meaning Single Family Residential – Single Story*).

In addition, the PIDF-LO should contain the Method Token that describes the way the location information was derived (i.e. from the NEAD or ELS). The Serving Core Network will assign a Method Token based upon a quality level rating. New location method tokens, NEAD-CVC, NEAD-DL1, and NEAD-DL2 associated with location information provisioned in the NEAD, and ELS-CVC, ELS-DL1, and ELS-DL2 associated with External Location Services are shown below. One of these Method Tokens will be populated in the PIDF-LO that is to be forwarded to the Next Generation Core Services System .

The Table below is extracted from ATIS-0700028.

ATIS-0700028 Table 7-2 – LS Location Method Tokens

Token	Description	Reference	Registration Date
NEAD-CVC	Civic Location	ATIS/WTSC-ELOC*	TBD
NEAD-DL1	Dispatchable Civic Location – medium-level	ATIS/WTSC-ELOC*	TBD
NEAD-DL2	Dispatchable Civic Location – highest level	ATIS/WTSC-ELOC*	TBD
ELS-CVC	Civic Location	ATIS/WTSC-ELOC*	TBD
ELS-DL1	Dispatchable Civic Location – medium-level	ATIS/WTSC-ELOC*	TBD
ELS-DL2	Dispatchable Civic Location – highest level	ATIS/WTSC-ELOC*	TBD

An XML example:

<method>NEAD-DL2</method>

* NOTE: Reference IANA registry URL for location method token values:

https://www.iana.org/assignments/method-tokens/method-tokens.xhtml#method-tokens-1

This registry value is added on a first-come, first-served basis.

Note that while the Serving Core Network may obtain Uncompensated Barometric Pressure (UBP) there is currently no method to provide that to the NG9-1-1 PSAP. The PIDF-LO must be extended to carry it. NENA has created a new issue to define the UBP extension.

Where a civic address is provided in addition to a geodetic location, a legacy PSAP may need to decide whether to map based on the civic address or geodetic location. Where a PSAP receives a civic address that does not map correctly it will use standard operating procedures to resolve it. Before the rollout of the service, functional testing should be performed to ensure that all enhanced location data is received and displayed properly. Training of 9-1-1 Operations and PSAP personnel related to the receipt and processing of enhanced location is required. Because in the context of a NG9-1-1 Emergency Services Network the Method Token will indicate whether the data error is in the NEAD or ELS, future consideration should be given to whether such can in any way expedite civic address data error resolution process.

[14] PIDF-LO PLC