ATIS STANDARD

ATIS-0500041

ATIS Standard on -

High-Level Description and Operational Guidelines for ATIS-0500036

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ATIS Standard on

High-Level Description and Operational Guidelines for ATIS-0500036

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Abstract

This document provides an overview and operational considerations for network interconnection based upon ATIS-0500036, *ATIS Standard for IMS-based Next Generation Emergency Services Network Interconnection*. ATIS-0500036 provides specifications for the interconnection of an IMS-based NG9-1-1 Emergency Services Network with legacy and other Next Generation NG9-1-1 Emergency Services Networks for initial emergency call origination and call transfers (bridging).

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 (NGES) Subcommittee was responsible for the development of this document.

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1 Scope, Purpose, & Application

1.1 Scope

The purpose of this Standard is to provide an overview and operations considerations for ATIS-0500036 [Ref 4], *ATIS Standard for IMS-based Next Generation Emergency Services Network Interconnection* [Ref 28] which defined the Stage 2 (architecture) and Stage 3 (protocols) to enable the interconnection of North American IMS-based NG9-1-1 Emergency Services Networks with other legacy and Next Generation Emergency Services Networks deployed in North America to support the delivery of initial and transferred emergency calls.

1.2 Purpose

The purpose of this standard is to provide an overview of and discuss operational and deployment topics related to ATIS-0500036 [Ref 4].

1.3 Application

This standard applies to the following entities:

- NG9-1-1 System Service Providers that support IMS-based NG9-1-1 emergency services network architectures
- NG9-1-1 System Service Providers that support i3 NG9-1-1 emergency services network architectures and need to understand emergency services interoperability.
- E9-1-1 System Service Providers that support legacy emergency services network architectures and need to support interoperability with IMS-based NG9-1-1 emergency services network architectures.

2 Normative 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] J-STD-036-C, *Enhanced Wireless 9-1-1 Phase II*, June 2011 including the addendum in J-STD-036-C-2, *Addendum to J-STD-036-C, Enhanced Wireless 9-1-1 Phase II*.[1]

[Ref 2] NENA-STA-010, *Detailed Functional and Interface Standards for the NENA i3 Solution*.[2]

[Ref 3] ATIS-0500032, *ATIS Standard for Implementation of a 3GPP IMS-based NG9-1-1 Emergency Services Network*.[1]

[Ref 4] ATIS-0500036, *ATIS Standard for IMS-based Next Generation Emergency Services Network Interconnection*[1]

[1] This document is available from the Alliance for Telecommunications Industry Solutions (ATIS), 1200 G Street N.W., Suite 500, Washington, DC 20005 at: < https://www.atis.org/ >

[2] This document is available from the National Emergency Number Association at: <NENA Standards & Other Documents>

3 Informative References

[Ref 101] NENA-ADM-000.21.1-2018, *NENA Master Glossary of 9-1-1 Terminology*.[2]

[Ref 102] NENA-INF-008.1 *NENA NG9-1-1 Transition Plan Information Document*.[2]

4 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 >.

4.1 Definitions

Emergency Call Routing Function (ECRF)[3]	A functional element in an ESInet that is a LoST protocol server where location information (either civic address or geo-coordinates) and a Service URN serve as input to a mapping function that returns a URI used to route an emergency call toward the appropriate PSAP for the caller's location or towards a responder agency.
Emergency Services IP network (ESInet)[4]	A managed IP network that is used for emergency services communications, and that can be shared by all public safety agencies. It provides the IP transport infrastructure upon which independent application platforms and core functional processes can be deployed, including, but not restricted to, those necessary for providing NG9-1-1 services. ESInets may be constructed from a mix of dedicated and shared facilities. ESInets may be interconnected at local, regional, state, federal, national, and international levels to form an IP-based inter-network (network of networks).
Location by Value (LbyV)	Location by Value refers to the option to deliver the caller's location to the PSAP within the body of the call request (SIP INVITE).
NG9-1-1[5]	An IP-based system comprised of managed IP-based networks (ESInets), functional elements (applications), and databases that replicate traditional E9-1-1 features and functions and provide additional capabilities. NG9-1-1 is designed to provide access to emergency services from all connected communications sources and provide multimedia data capabilities for PSAPs and other emergency service organizations.
pANI (Pseudo Automatic Number Identification)	A telephone number used to support routing of wireless 9-1-1 calls. It may identify a wireless cell, cell sector, or PSAP to which the call should be routed. Also known as routing number.
Reference Identifier	The term "Reference Identifier" is used in this standard to associate the call with location information of the caller. For routing to a legacy emergency services network, a Reference Identifier may be an Emergency Services Routing Key (ESRK) or Emergency Services Routing Digit (ESRD) as defined in J-STD-036-C [Ref 1]. It may be the Telephone Number that is used by the legacy emergency services network to query for location information. In a legacy emergency services network, the Reference Identifier may also be used by the emergency services network to route the call to the PSAP. For calls routed to a NENA i3 ESInet, the Reference Identifier may be a dereferencing URI that is used by i3 functional elements and i3 PSAPs to obtain location.[6]

[3] Refer to NENA-ADM-000.21.1-2018, NENA Master Glossary of 9-1-1 Terminology [Ref 101].

[4] Refer to NENA i3/NG9-1-1 [Ref 23].

[5] The term "NG911" used throughout this document is synonymous with the term "NG9-1-1".

[6] Use of an Emergency Services Query Key (ESQK) as a Reference Identifier is for further study, pending the definition of use cases and call flows that illustrate the circumstances under which an ESQK applies.

4.2 Acronyms & Abbreviations

3GPP	Third Generation Partner Program
ALI	Automatic Location Identification
ANI	Automatic Number Identification
AS	Application Server
ATIS	Alliance for Telecommunications Industry Solutions
CAD	Computer Aided Dispatch
CHE	Call Handline Equipment
E-CSCF	Emergency Call Session Control Function
ECRF	Emergency Call Routing Function (NENA i3)
EIDD	Emergency Incident Data Document
EIDO	Emergency Information Data Object
ESInet	Emergency Services IP network
ESN	Emergency Service Number
ESQK	Emergency Services Query Key
ESRD	Emergency Services Routing Digits
ESRK	Emergency Services Routing Key
ESRP	Emergency Service Routing Proxy
GIS	Geographic Information System
HELD	HTTP-Enabled Location Delivery
HTTP	Hypertext Transfer Protocol
HTTPS	HTTP Secure
IAM	Initial Address Message
I-CSCF	Interrogating Call Session Control Function
IMS	IP Multimedia Subsystem
IP	Internet Protocol
LbyV	Location by Value
LoST	Location to Service Translation Protocol
LRF	Location Retrieval Function
LSRG	Legacy Selective Router Gateway
MF	Multi Frequency
NENA	National Emergency Number Association
NGCS	Next Generation 9-1-1 Core Services
pANI	pseudo Automatic Number Identification
PIDF-LO	Presence Information Data Format – Location Object
PRF	Policy Routing Function
PSAP	Public Safety Answering Point
RDF	Routing Determination Function
RMS	Records Management System
SIP	Session Initiation Protocol
SR	Selective Router
SRDB	Selective Routing Database

SS7	Signaling System Number 7
TN	Telephone Number
URI	Uniform Resource Identifier
URN	Uniform Resource Name
VoIP	Voice over IP

5 Internetwork Architectural Configuration

Figure 5.1 illustrates the concept of network interconnection for the purpose of delivering emergency calls to an interconnected emergency services network or transferring calls between Emergency Services Networks.

When a call enters the Upstream IMS-based NG9-1-1 Emergency Services Network[7], it may be routed to a PSAP served by that network or the network may send the call to a downstream emergency services network. The following bullets describe various scenarios.

- In the case of an IMS-based NG9-1-1 Emergency Services Network to IMS-based NG9-1-1 Emergency Services Network call, the use case may be where there is a hierarchy of Emergency Services Networks and the Upstream IMS-based NG9-1-1 Emergency Services Network sends the call to the Downstream IMS-based NG9-1-1 Emergency Services Network to be delivered to the PSAP served by the Downstream Emergency Services Network.
- There may be Geographic Information System (GIS) boundary cases where the Upstream IMS-based NG9-1-1 Emergency Services Network determines that the call should be handled by a Downstream IMS-based NG9-1-1 Emergency Services Network (which really means a peer emergency services network that may handle that geographic area).
- There may be cases where an Upstream IMS-based NG9-1-1 Emergency Services Network sends an emergency call to a downstream i3 NG9-1-1 Emergency Services Network.
- There may be cases where calls entering an Upstream IMS-based NG9-1-1 Emergency Services Network must be sent to a legacy Emergency Services Network.
- There may be cases where calls from a legacy Emergency Services network may be sent to an IMS-based NG9-1-1 Emergency Services Network or i3 NG9-1-1 Emergency Services Network.

Note that scenarios where emergency calls pass between legacy Emergency Services Networks and i3 NG9-1-1 Emergency Services Networks without the involvement of an IMS-based NG9-1-1 Emergency Services Network are outside the scope of this specification.

In addition, calls may be transferred from one emergency services network to another. For example:

- A PSAP served by an Upstream IMS-based NG9-1-1 Emergency Services Network may transfer a call to a PSAP in a Downstream IMS-based NG9-1-1 Emergency Services Network.
- Calls may be transferred between PSAPs in an IMS-based NG9-1-1 Emergency Services Network and PSAPs in a legacy Emergency Services Network.
- Calls may be transferred between PSAPs served by an IMS-based NG9-1-1 Emergency Services Network and PSAPs served by i3 NG9-1-1 Emergency Services Networks.

[7] The terms Upstream IMS-based NG9-1-1 Emergency Services Network and Upstream Legacy Emergency Services Network are meant to imply the originating emergency services network that is sending an emergency request (initial or bridged) to another emergency services network. The terms Downstream IMS-based NG9-1-1 Emergency Services Network and Downstream Legacy Emergency Services Network are meant to imply the emergency services network that is receiving the initial call request from the other emergency services network or is the recipient of the call transfer.

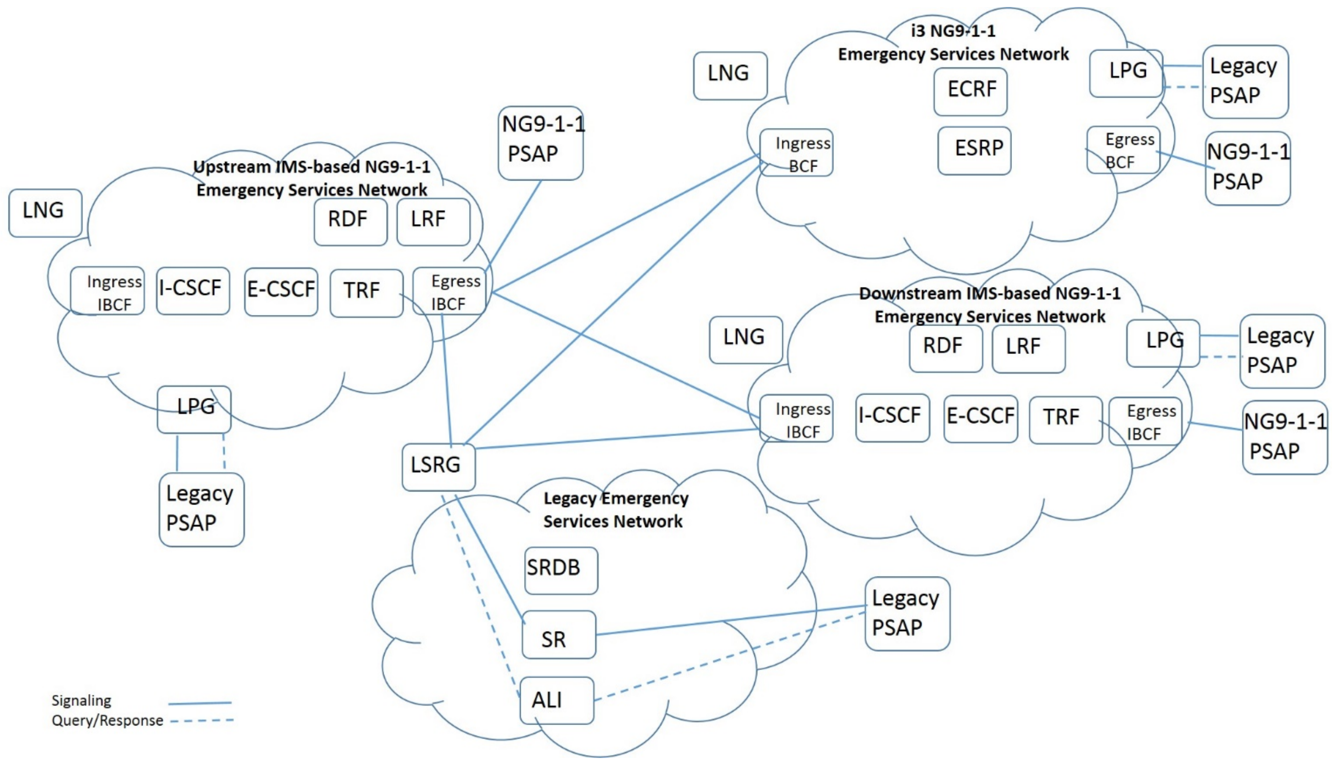

Figure 5.1 – Internetwork Architectural Configuration

See ATIS-0500036 [Ref 4] for a detailed description of the IMS elements illustrated in this diagram.

See NENA-STA-010 [Ref 2] for a detailed description of the i3 NG9-1-1 functional elements illustrated in this diagram.

To facilitate the interconnection between an IMS-based NG9-1-1 Emergency Services Network and a legacy Emergency Services Network a new functional element has been adopted – the Legacy Selective Router Gateway (LSRG) as defined by NENA. The LSRG supports interconnection with the legacy Emergency Services Network.

The following is the definition for the LSRG as specified in the NENA NG9-1-1 Transition Plan Information Document (NENA-INF-008.1) [Ref 102]:

> *"The Legacy SR Gateway (LSRG) is a gateway that facilitates the routing/transfer of emergency calls between the ESInet and the legacy emergency services network. The LSRG will have to interwork location infrastructure between NG9-1-1 and legacy emergency services environments."*

6 Interconnection Call Flows

This section illustrates various scenarios for emergency calls exchanged between IMS-based NG9-1-1 Emergency Services Networks (i.e., NG9-1-1 Emergency Services Networks that conform to ATIS-0500032 [Ref 3]), between IMS-based NG9-1-1 Emergency Services Networks and NENA i3 NG9-1-1 Emergency Services Networks (i.e., NG9-1-1 Emergency Services Networks that conform to NENA-STA-010 [Ref 2]), and between IMS-based NG9-1-1 Emergency Services Networks and legacy Emergency Services Networks, where Emergency Services Network interconnection is based upon ATIS-0500036 [Ref 4].

There are two sets of scenarios: initial calls that are received by one emergency services network and forwarded to another; and calls that are transferred between a PSAP served by one network and a PSAP served by another. The terms Upstream IMS-based NG9-1-1 Emergency Services Network and Downstream IMS-based NG9-1-1 Emergency Services Network are used in the discussion. For an initial call that enters the Upstream IMS-based NG9-1-1 Emergency Services Network there may be a need to forward that call to another IMS-based NG9-1-1 Emergency Services Network (i.e. the Downstream IMS-based NG9-1-1 Emergency Services Network). There may also be a need for a PSAP served by the Upstream IMS-based NG9-1-1 Emergency Services Network to transfer a call to a PSAP in another IMS-based NG9-1-1 Emergency Services Network (i.e. Downstream IMS-based

NG9-1-1 Emergency Services Network). For the interactions between an IMS-based NG9-1-1 Emergency Services Network and a legacy Emergency Services Network or i3 NG9-1-1 Emergency Services Network there may be a need to either send initial calls or bridged/transferred calls in either direction. For simplicity, all of the example call flows illustrated below assume that location is provided "by value" in SIP signaling.

The following seven call flows illustrate routing or transferring emergency calls between different Emergency Services Networks:

- Initial Call – Upstream IMS-based NG9-1-1 Emergency Services Network to downstream IMS-based NG 9-1-1 Emergency Services Network
- Initial Call – Upstream IMS-based NG9-1-1 Emergency Services Network to legacy Emergency Services Network
- Initial Call – legacy Emergency Services Network to IMS-based NG9-1-1 Emergency Services Network
- Initial Call – IMS-based NG 9-1-1 Emergency Services Network to NENA i3 NG9-1-1 Emergency Services Network
- Initial Call – NENA i3 NG 9-1-1 Emergency Services Network to IMS-based NG9-1-1 Emergency Services Network
- Transfer call – legacy Emergency Services Network to IMS-based NG9-1-1 Emergency Services Network
- Transfer call – IMS-based NG 9-1-1 Emergency Services Network to legacy Emergency Services Network.

6.1 Initial Call from an Upstream IMS-based NG9-1-1 Emergency Services Network to Downstream IMS-based NG9-1-1 Emergency Services Network

Figure 6.1 illustrates a scenario where a call enters the Upstream IMS-based NG9-1-1 Emergency Services Network and is delivered to the Downstream IMS-based NG9-1-1 Emergency Services Network.

Specifically, when the Location Retrieval Function (LRF) in the Upstream IMS-based NG9-1-1 Emergency Services Network queries the Routing Determination Function (RDF), the RDF determines that, for this location, the call should be handed off to the Downstream IMS-based NG9-1-1 Emergency Services Network for processing. There may also be a scenario where the Policy Routing Function (PRF) in the LRF determines the call should be handed off to the Downstream IMS-based NG9-1-1 Emergency Services Network. Therefore, the LRF returns routing instructions to the Emergency Call Session Control Function (E-CSCF) that specify the Downstream IMS-based NG9-1-1 Emergency Services Network. The call is delivered to the Downstream IMS-based NG9-1-1 Emergency Services Network and that network routes the call based upon the location provided.

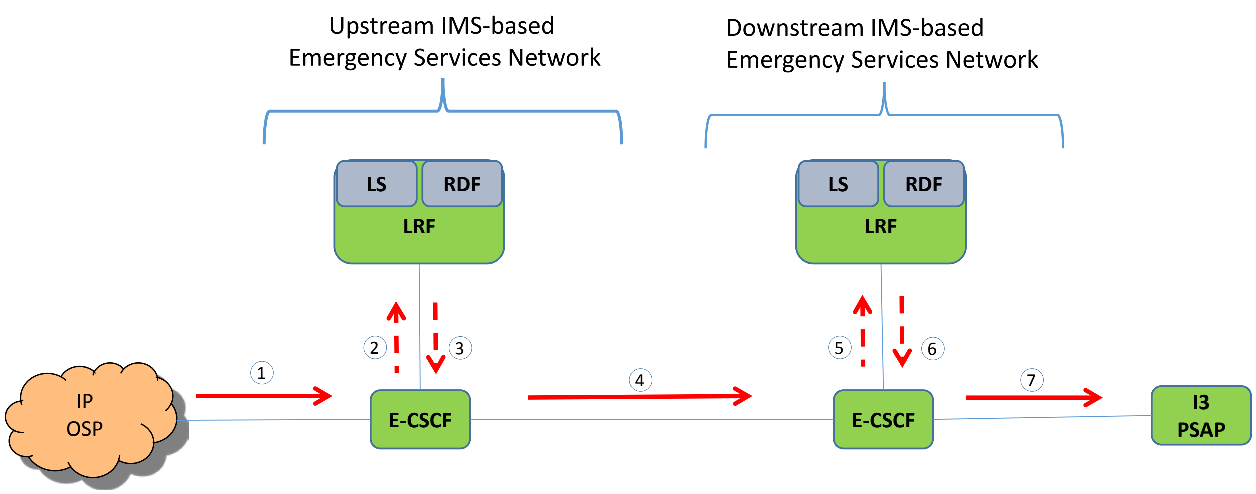

Figure 6.1 – Initial Call from an Upstream IMS-based NG9-1-1 Emergency Services Network to Downstream IMS-based NG9-1-1 Emergency Services Network

Step 1. The originating network sends an emergency call origination to the E-CSCF in the IMS-based NG9-1-1 Emergency Services Network. The SIP INVITE message includes callback information, location by value (LbyV), and Additional Data (by value).

Step 2. The E-CSCF forwards the SIP INVITE to the LRF to obtain routing instructions.

Step 3. The LRF queries the RDF using the location information in the body of the received SIP INVITE message and the RDF determines that the call is destined to the Downstream IMS-based NG9-1-1 Emergency Services Network. The LRF redirects the call back to the E-CSCF, passing routing information.

Step 4. The E-CSCF generates an outgoing SIP INVITE message, using the information received from the LRF as well as information received in the initial SIP INVITE message, and forwards it to the E-CSCF in the Downstream IMS-based NG9-1-1 Emergency Services Network. The SIP INVITE message contains the LbyV in the body and Additional Data (by value) in the body.

Step 5. The E-CSCF in the Downstream IMS-based NG9-1-1 Emergency Services Network forwards the SIP INVITE to the LRF to request routing instructions.

Step 6. The LRF queries the RDF using the location information received in the body of the received SIP INVITE message and the RDF determines the destination PSAP. The LRF redirects the call back to the E-CSCF, passing routing information.

Step 7. The E-CSCF generates an outgoing SIP INVITE message, using the information received from the LRF as well as information received in the initial SIP INVITE message, and forwards it to the PSAP. The SIP INVITE message contains the LbyV in the body and Additional Data (by value) in the body.

6.2 Initial Call from an Upstream IMS-based NG9-1-1 Emergency Services Network to Downstream Legacy Emergency Services Network

For this scenario (Figure 6.2) the caller's location, in the form of location by value, and Additional Data (by value) are included in the call request from the originating network to the IMS-based NG9-1-1 Emergency Services Network. However, due to the limits of the legacy Emergency Services Network to which the emergency call is to be forwarded, the location information and Additional Data cannot be passed in the call set up signaling via the legacy Selective Router (SR) to the legacy PSAP. In this call scenario, the LSRG sends a pseudo ANI (pANI) to the legacy PSAP via the legacy Selective Router, and the legacy PSAP queries the LSRG (through the ALI system) for location information and callback number. That is, the LSRG caches the location information and Additional Data received in incoming SIP signaling, allocates a pANI and sends the pANI to the legacy PSAP (through the SR) in the call request. This method is similar to the methods used for wireless and VoIP emergency calls. The legacy PSAP then queries its ALI system which steers the request to the LSRG. The location, callback number, and other data are provided in the response.

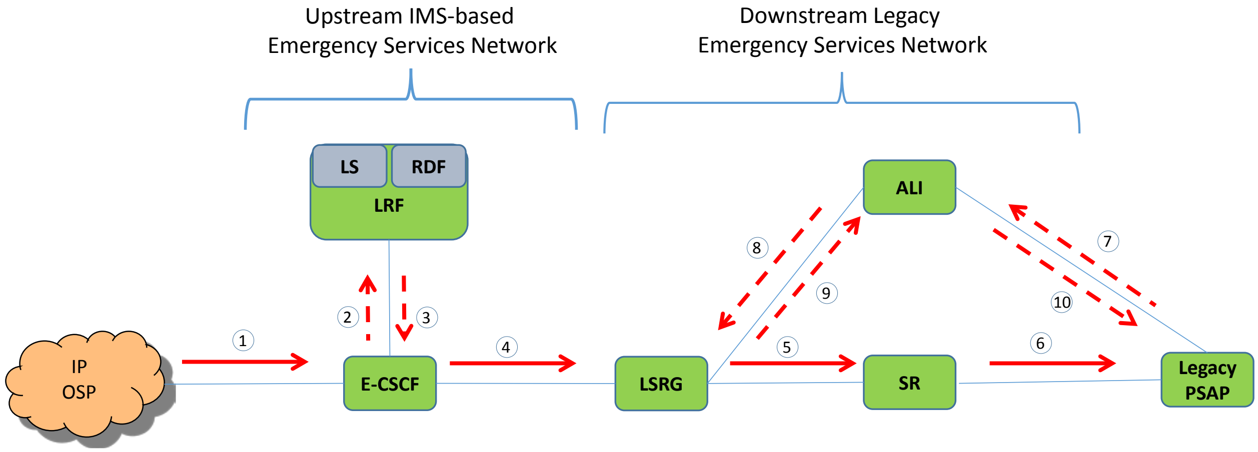

Figure 6.3 – Initial Call from an Upstream IMS-based NG9-1-1 Emergency Services Network to Downstream Legacy Emergency Services Network

Step 1. The originating network sends an emergency call origination to the E-CSCF in the IMS-based NG9-1-1 Emergency Services Network. The SIP INVITE message includes callback information, location by value (LbyV), and Additional Data (by value).

Step 2. The E-CSCF forwards the SIP INVITE to the LRF.

Step 3. The LRF queries the RDF using the location information received in the body of the received SIP INVITE message and the RDF determines that the call is destined to the Downstream legacy Emergency Services Network. The LRF redirects the call back to the E-CSCF, passing routing information.

Step 4. The E-CSCF generates an outgoing SIP INVITE message to the LSRG, using the information received from the LRF as well as information received in the initial SIP INVITE message.

Step 5. The LSRG caches the location and additional data information and creates a pANI based upon the destination PSAP. It initiates an SS7 Initial Address Message (IAM) to the Selective Router in the legacy Emergency Services Network. The IAM includes the pANI and the PSAP Directory Number.

Step 6. Since the RDF selected the PSAP, and the LSRG created a pANI appropriate to the destination PSAP, the Selective Router does not need to perform selective routing. The SR sends the call request to the PSAP with the pANI.

Step 7. The PSAP queries the ALI system with the pANI.

Step 8. The ALI system queries the LSRG with the pANI.

Step 9. The LSRG returns the location information, callback number, and other data to the ALI system.

Step 10. The ALI system returns the location information, callback number, and other data to the PSAP.

6.3 Initial Call from an Upstream Legacy Emergency Services Network to Downstream IMS-based NG9-1-1 Emergency Services Network

Figure 6.3 illustrates the scenario where a wireline call is initially delivered to a legacy Emergency Services Network and is forwarded to an IMS-based NG9-1-1 Emergency Services Network for processing. Specifically, the call is sent to the SR and the SR queries the Selective Routing Database (SRDB) for routing instructions. The SRDB returns an Emergency Service Number (ESN) and that ESN is associated with a Tandem to Tandem trunk group to the LSRG. The SR then initiates an SS7 IAM toward the LSRG, the LSRG queries the ALI system for location information and other data and the LSRG converts the legacy information into a format that is appropriate for delivery to the IMS-based NG9-1-1 Emergency Services Network (e.g. location-by-value in a PIDF-LO in the body of the SIP INVITE message, and Additional Data by value in the body of the SIP INVITE message). The call is then routed within the IMS-based NG9-1-1 Emergency Services Network using the location information provided by the LSRG.

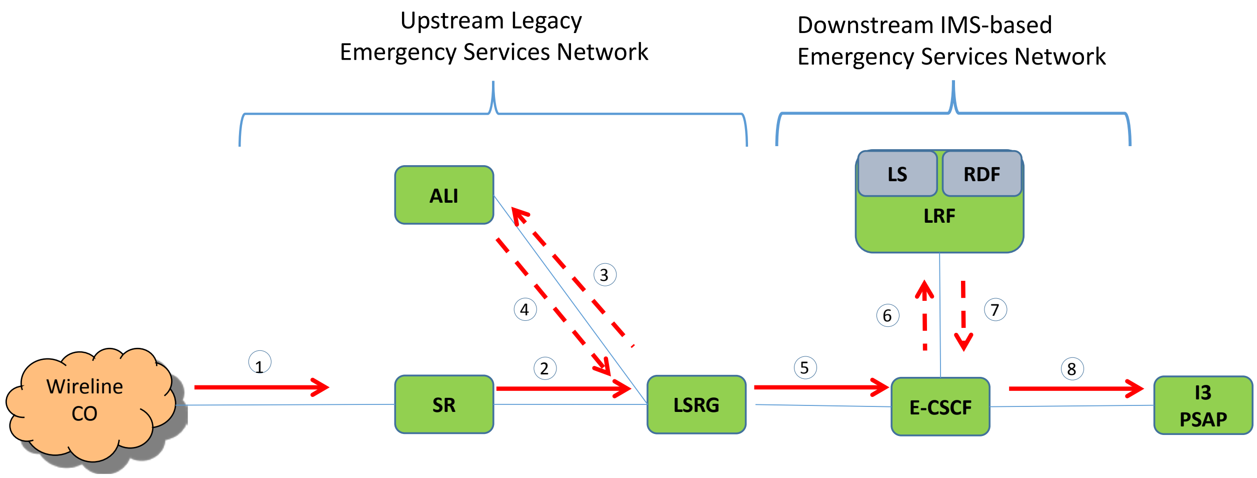

Figure 6.5 – Initial Call from an Upstream Legacy Emergency Services Network to Downstream IMS-based NG9-1-1 Emergency Services Network

Step 1. The Wireline Central Office switch initiates a 9-1-1 call using the SS7 protocol. The call is forwarded to the SR.

Step 2. The SR queries its SRDB (not shown) with the caller's TN and the SRDB returns an ESN that points to Tandem to Tandem trunks toward the LSRG. The SR creates an SS7 IAM toward the LSRG with the Called Party Number as "911" and the Calling Party Number as the telephone number of the caller.

Step 3. The LSRG queries the ALI with the TN to obtain legacy location information and other data.

Step 4. The ALI returns the legacy location information and other data.

Step 5. The LSRG reformats the legacy ALI information into a location-by-value (i.e. PIDF-LO) and additional data information and incorporates that information into a SIP INVITE that it forwards to an E-CSCF in the Downstream IMS-based NG9-1-1 Emergency Services Network.

Step 6. The E-CSCF forwards the SIP INVITE to the LRF.

Step 7. The LRF queries the RDF using the location information received in the body of the received SIP INVITE message, and the RDF returns a Route URI indicating the i3 PSAP. The LRF redirects the call back to the E-CSCF, passing the PSAP URI.

Step 8. The E-CSCF generates an outgoing SIP INVITE message, using the information received from the LRF as well as information received in the initial SIP INVITE message, and forwards it to the PSAP. The SIP INVITE message contains the callback information, the LbyV in the body and Additional Data (by value) in the body.

6.4 Initial Call from an IMS-based NG9-1-1 Emergency Services Network to a NENA i3 ESInet

Figure 6.4 illustrates a scenario where an initial emergency call enters an Upstream IMS-based NG9-1-1 Emergency Services Network and is delivered to a Downstream i3 NG9-1-1 Emergency Services Network. Specifically, when the LRF in the Upstream IMS-based NG9-1-1 Emergency Services Network queries the RDF, the RDF determines that, for this location, the call should be handed off to the Downstream i3 NG9-1-1 Emergency Services Network for processing. There may also be a scenario where the PRF in the LRF determines the call should be handed off to the Downstream i3 NG9-1-1 Emergency Services Network. Therefore, the LRF returns a Route URI that is associated with an Emergency Service Routing Proxy (ESRP) in the Downstream i3 NG9-1-1 Emergency Services Network. The call is delivered to the Downstream i3 NG9-1-1 Emergency Services Network and it routes the call based upon the location provided.

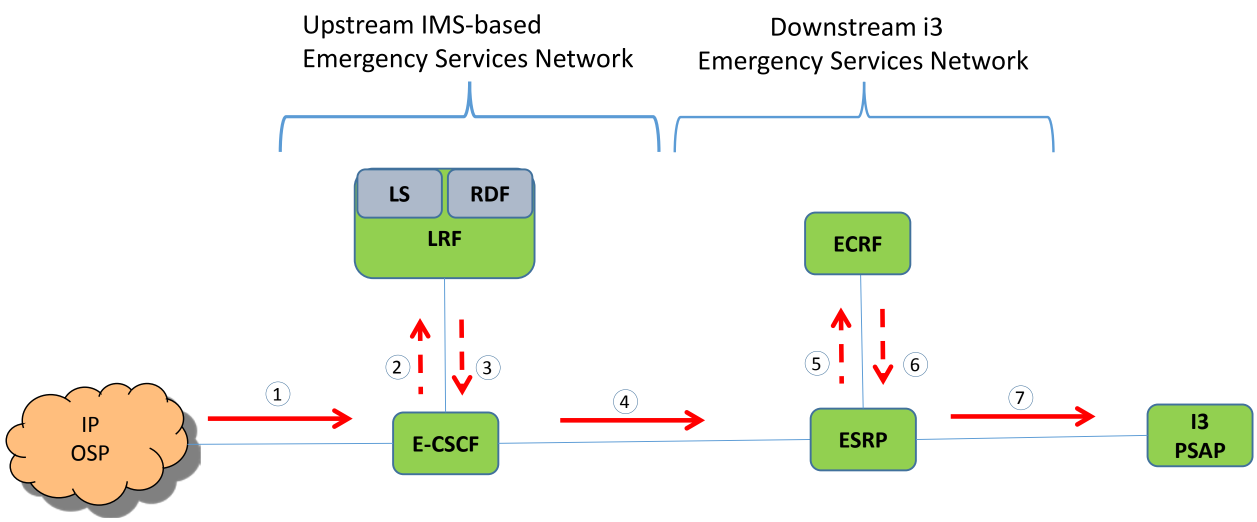

Figure 6.7 – Initial Call from an IMS-based NG9-1-1 Emergency Services Network to a NENA i3 ESInet

Step 1. The originating network sends an emergency call origination to an E-CSCF in the IMS-based NG9-1-1 Emergency Services Network. The SIP INVITE message includes callback information, LbyV, and Additional Data (by value).

Step 2. The E-CSCF forwards the SIP INVITE to the LRF.

Step 3. The LRF queries the RDF using the location information received in the body of the received SIP INVITE message. The RDF returns a Route URI. In this example, the Route URI is associated with an ESRP in a Downstream i3 NG9-1-1 Emergency Services Network. The LRF redirects the call back to the E-CSCF, passing the Route URI.

Step 4. The E-CSCF generates an outgoing SIP INVITE message to the ESRP in the Downstream NENA i3 ESInet, using the information received from the LRF as well as information received in the initial SIP INVITE message. The SIP INVITE message contains the callback information, the LbyV in the body and Additional Data (by value) in the body.

Step 5. The ESRP queries the ECRF using the location information received in the body of the SIP INVITE.

Step 6. The ECRF returns a Route URI. In this example, the Route URI (PSAP URI) is associated with an i3 PSAP.

Step 7. The ESRP generates an outgoing SIP INVITE message, using the information received from the ECRF as well as information received in the initial SIP INVITE message, and forwards it to the i3 PSAP. The SIP INVITE message contains the callback information, the LbyV and Additional Data (by value) in the body.

6.5 Initial Call from NENA i3 ESInet to an IMS-based NG9-1-1 Emergency Services Network

Figure 6.5 illustrates a scenario where an initial emergency call enters an Upstream i3 NG9-1-1 Emergency Services Network, and is delivered to a Downstream IMS-based NG9-1-1 Emergency Services Network. Specifically, the ESRP in the Upstream i3 NG9-1-1 Emergency Services Network queries the ECRF and the ECRF determines that, for this location, the call should be handed off to the Downstream IMS-based NG9-1-1 Emergency Services Network for processing. There may also be a scenario where the PRF in the ESRP determines the call should be handed off to the Downstream IMS-based NG9-1-1 Emergency Services Network. Therefore, the ECRF returns a Route URI that is associated with the Downstream IMS-based NG9-1-1 Emergency Services Network. The call is delivered to the Downstream IMS-based NG9-1-1 Emergency Services Network and the LRF interacts with the RDF to route the call based upon the location provided. In this call flow, the call is routed to an i3 PSAP.

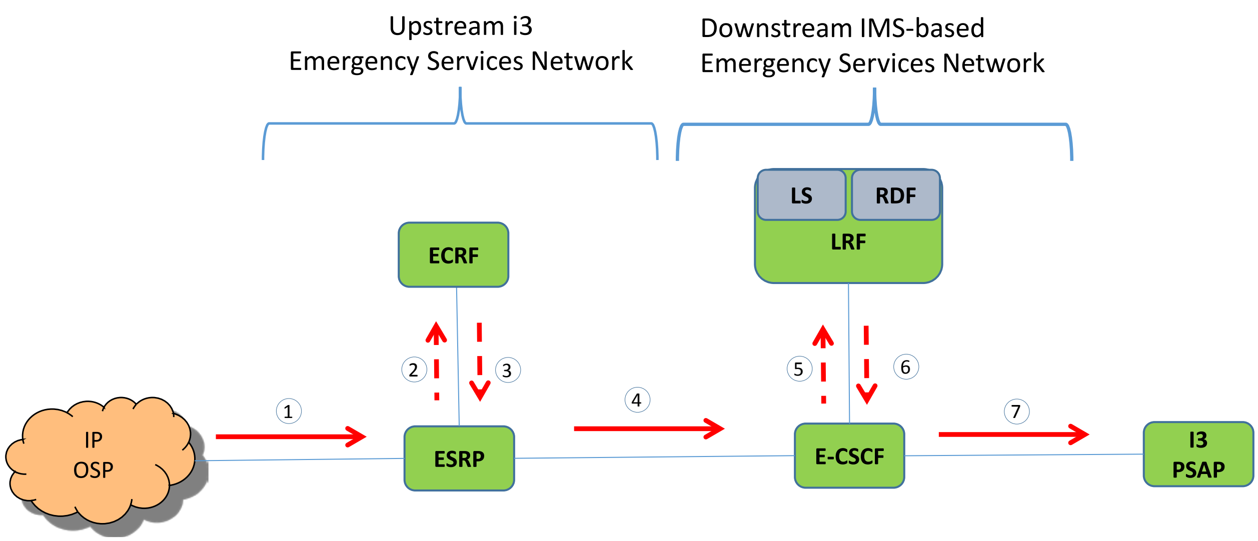

Figure 6.9 – Initial Call from NENA i3 ESInet to an IMS-based NG9-1-1 Emergency Services Network

Step 1. The originating network sends an emergency call origination to an ESRP in the i3 NG9-1-1 Emergency Services Network. The SIP INVITE message includes callback information, LbyV, and Additional Data (by value).

Step 2. The ESRP queries the ECRF using the location information received in the body of the received SIP INVITE message

Step 3. The ECRF returns a Route URI. In this example, the Route URI is associated with an I-CSCF in a Downstream IMS-based NG9-1-1 Emergency Services Network.

Step 4. The ESRP generates an outgoing SIP INVITE message, using the information received from the ECRF as well as information received in the initial SIP INVITE message, and forwards it to the I-CSCF (not shown) which in turn forwards it to the E-CSCF. The SIP INVITE message contains the callback information, the LbyV in the body and Additional Data (by value) in the body.

Step 5. The E-CSCF forwards the SIP INVITE to the LRF.

Step 6. The LRF queries the RDF using the location information received in the body of the received SIP INVITE message. The RDF returns a Route URI. In this example, the Route URI (PSAP URI) is associated with an i3 PSAP. The LRF redirects the call back to the E-CSCF, passing the PSAP URI.

Step 7. The E-CSCF generates an outgoing SIP INVITE message, using the information received from the LRF as well as information received in the initial SIP INVITE message, and forwards it to the i3 PSAP. The SIP INVITE message contains the callback information, the LbyV in the body and Additional Data (by value).

6.6 Call Transfer from a Legacy Emergency Services Network to an IMS-based NG9-1-1 Emergency Services Network

The scenario in Figure 6.6 illustrates a transfer initiated by a PSAP served by an Upstream legacy Emergency Services Network to a PSAP served by a Downstream IMS-based NG9-1-1 Emergency Services Network. The SR recognizes that the transfer-to PSAP is served by a foreign network (i.e., Downstream IMS-based NG9-1-1 Emergency Services Network) and initiates a Tandem to Tandem connection to the LSRG. The LSRG obtains the ALI information and formats location and additional data appropriate for the Downstream IMS-based NG9-1-1 Emergency Services Network. It uses that information to populate an Emergency Information Data Object (EIDO[8]). The call is then destination-routed to the PSAP and the PSAP queries the LSRG for the EIDO which contains callback, location information and additional data.

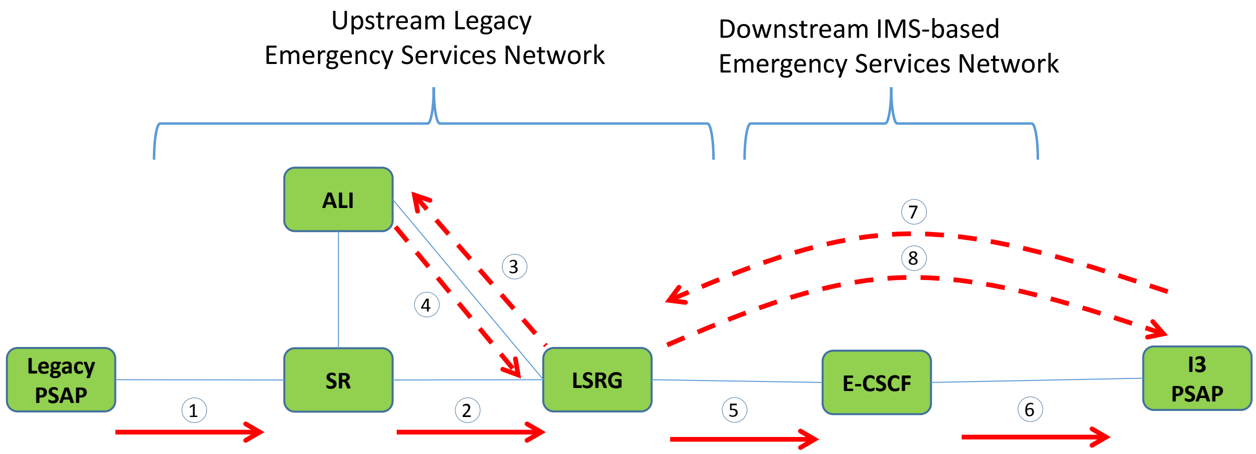

Figure 6.11 – Call Transfer from a Legacy Emergency Services Network to an IMS-based NG9-1-1 Emergency Services Network

Step 1. The Primary (i.e., transfer-from) PSAP determines that it needs to transfer an emergency call and therefore sends a “star” code to the SR indicating that it wants to selectively transfer the call. (Note the PSAP may indicate a manual transfer in which case it provides the directory number of the transfer-to PSAP.)

Step 2. The SR accesses internal tables and determines that the outgoing route is associated with the Tandem to Tandem trunks to the LSRG. The SR initiates an SS7 IAM to the LSRG including the directory number of the destination PSAP and the Calling Party Number.

Step 3. The LSRG queries the ALI with the content of the Calling Party Number it received in the SS7 IAM.

Step 4. The ALI returns a fixed formatted message containing legacy ALI location information and other data.

Step 5. The LSRG reformats the information returned by the ALI system into an EIDO. It puts a reference URI to the EIDO in the Call-Info header. This can be used by the transfer-to PSAP to retrieve location and other Additional Data. The LSRG creates an INVITE with Route headers indicating the destination (transferred-to) PSAP and forwards the INVITE.

Step 6. The E-CSCF, recognizing that there is a Route header for the destination PSAP, does not perform location-based routing, but forwards the INVITE toward the destination PSAP, including the EIDO reference. Note that policy routing may be performed, and if so, will require that the E-CSCF pass the INVITE to the LRF (not shown).

Step 7. The PSAP queries the LSRG with the EIDO reference URI.

Step 8. The LSRG returns the EIDO containing callback, location information, and additional data.

[8] EIDO is the successor to Emergency Incident Data Document (EIDD).

6.7 Call Transfer from an IMS-based NG9-1-1 Emergency Services Network to a Legacy Emergency Services Network

In Figure 6.7 a Primary (transfer-from) PSAP served by an IMS-based NG9-1-1 Emergency Services Network determines that it needs to transfer an emergency call to a PSAP that is served by a legacy Emergency Services Network. The transfer-from PSAP creates a conference and invites the caller to the conference. Then the transfer-from PSAP sends a REFER to add the transfer-to PSAP in the Downstream Legacy Emergency Services Network to the conference. The REFER contains an EIDO URI. The Conference Application Server (AS) sends an INVITE toward the LSRG, identifying the PSAP in the legacy Emergency Services Network as the destination for the transferred call. The INVITE includes the EIDO URI. The LSRG dereferences the EIDO. The LSRG then allocates a pANI and converts the data received from the EIDO response to a format that can be used by the legacy Emergency Services Network. The LSRG initiates a Tandem to Tandem connection to the SR and the SR forwards the call to the destination PSAP along with the pANI. The PSAP queries the ALI system using the pANI and the ALI system steers the request to the LSRG. The LSRG returns the location information, callback information, and potentially additional data in the legacy format.

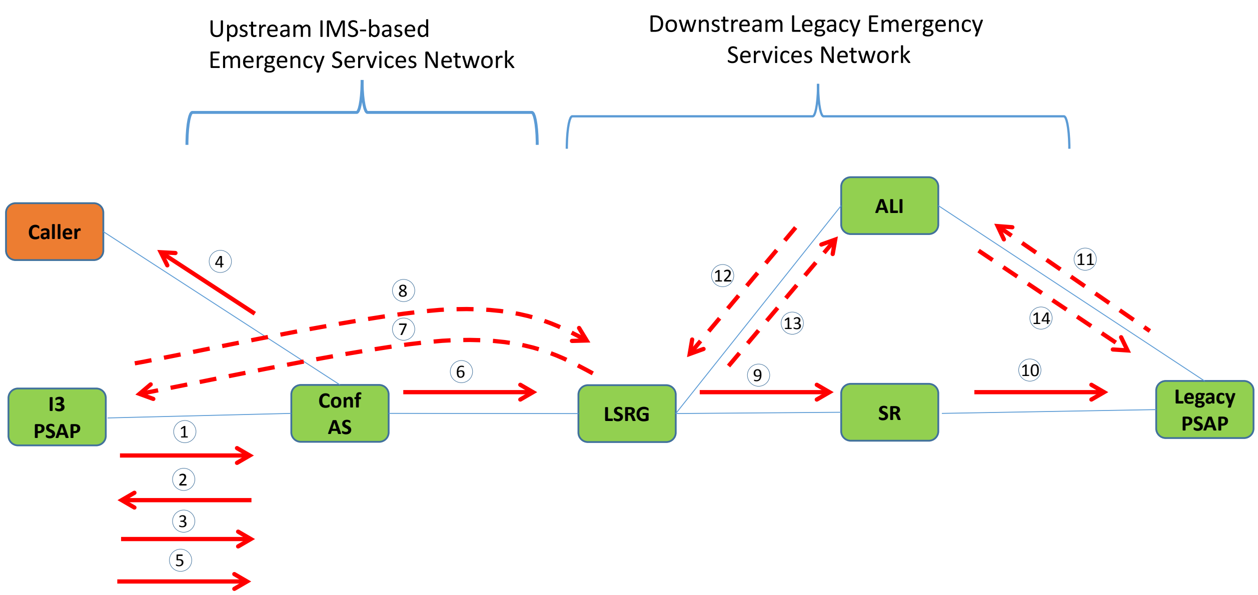

Figure 6.13 – Call Transfer from an IMS-based NG9-1-1 Emergency Services Network to a Legacy Emergency Services Network

Step 1. The Primary (transfer-from) PSAP determines that it needs to transfer an emergency call and therefore must create a conference using a Conference AS in the IMS-based NG9-1-1 Emergency Services Network. The transfer-from i3 PSAP creates the conference by first sending an INVITE to a Conference AS in the IMS-based NG9-1-1 Emergency Services Network.

Step 2. The Conference AS responds to the INVITE.

A session is established between the transfer-from i3 PSAP and the Conference AS.

Step 3. The Primary PSAP sends a REFER method to the Conference AS asking it to invite the Caller to the conference.

Step 4. The Conference AS invites the Caller to the conference.

A session is established between the Caller and the Conference AS.

Step 5. The Primary i3 PSAP sends a REFER method to the Conference AS asking it to invite the transfer-to legacy PSAP to the conference. The REFER contains the EIDO URI.

Step 6. The Conference AS sends an INVITE to the LSRG. The INVITE contains the EIDO URI.

Step 7. The LSRG sends a dereference request to the transfer-from PSAP to obtain the EIDO.

Step 8. The transfer-from PSAP returns the EIDO, and the LSRG reformats the data to a legacy format and creates a pANI that can be used to retrieve the information.

Step 9. The LSRG sends an SS7 IAM to the SR with the Called Party Number of the transfer-to PSAP and the pANI created by the LSRG in the Calling Party Number parameter.

Step 10. The SR delivers the call (including the pANI) to the PSAP using the appropriate MF signaling interface.

At this point the Caller, the transfer-from PSAP and the transfer-to PSAP are all participants in the conference.

Step 11. The transfer-to PSAP sends an ALI request to the ALI system that includes the pANI.

Step 12. The ALI system steers the request to the LSRG.

Step 13. The LSRG returns location, callback and other data to the ALI system formatted appropriately.

Step 14. The ALI system returns location, callback and other data to the transfer-to PSAP using an appropriate legacy format.

7 Operational Considerations

Seamless interoperability for all components of the NG9-1-1 system is always a fundamental public safety operational consideration. The use of commonly accepted standards helps facilitate interoperability through standardizing interfaces for signaling, data transmission and storage, and multimedia throughout the NG9-1-1 ecosystem.

For example, in the NENA i3 Standard for NG9-1-1, NG9-1-1 Core Services (NGCS) is a key component of the NG9-1-1 system that supports interoperability with other i3 compliant downstream systems [e.g., those that handle location or geospatial information, routing queries, additional data handling, test calls, discrepancy reporting, incident data, call media, bridging and transfer; or the interfaces to discrete components such as Call Handling Equipment (CHE), Computer Aided Dispatch (CAD), Records Management System (RMS), and other dispatch and first responder systems]. Due to the complexity of a transitional and end-state NG9-1-1 environment, conformance testing may require supporting assurances from vendors where different basic designs, other relevant standards, and implementation approaches are being used and updated.

This document provides a high-level overview and operational guidelines for system and network interconnection. A vendor designing, deploying, and maintaining a NENA i3 NGCS on an ESInet or IMS-based Next Generation 9-1-1 Emergency Services Network must consider compatibility and interconnection interoperability between their design and that of other interrelated NG9-1-1 systems. A public safety entity that is preparing to purchase or that is purchasing a NENA i3 ESInet and NGCS or IMS-based NG9-1-1 Emergency Services Network must use the appropriate level of additional attention and prudence. This includes, but is not limited to, additional specifications and conformance testing to fully address the fundamental public safety operational consideration of seamless interoperability between and among NENA i3 NGCS systems and IMS-based NG9-1-1 Emergency Services Networks.

Standards and guidelines, however, only facilitate an interoperable communications ecosystem: the mere existence of standards does nothing for interoperability if system service providers and public safety are not vigilant to ensure that implementations are conformant. This document provides some guidance for NG9-1-1 core service interconnection between different networks, including how networks may interconnect and how call flows will operate in different circumstances between these networks, and accordingly describes how these networks *should* perform in an interoperable environment. It is the responsibility of system service providers, through careful oversight, including conformance and interoperability testing, to ensure that networks do interoperate as intended.