NENA Legacy Selective Router Gateway (LSRG) Standard

Abstract: Legacy Selective Router Gateways (LSRGs) will provide the needed functionality to wireline and wireless callers and PSAPs that are served by legacy Selective Routers (SRs) to facilitate emergency call handling during the transition to NG9-1-1.

NENA Legacy Selective Router Gateway (LSRG) Standard

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1 Executive Overview

The National Emergency Number Association (NENA) NG9-1-1 Transition Plan Considerations Information Document (NENA-INF-008.1 [9]) employs a Legacy Selective Router Gateway (LSRG) as a key component of the transition from the Enhanced 9-1-1 (E9-1-1) system presently deployed to the Next Generation 9-1-1 (NG9-1-1) system (i.e., i3) described in NENA-STA-010.3-2021 [43]. The end-state i3 architecture assumes end-to-end Internet Protocol (IP) connectivity, and it is expected that, over time, an increasing number of calls will originate from i3-compliant originating networks and be delivered to i3 Public Safety Answering Points (PSAPs) via an i3 Emergency Services IP Network (ESInet) supporting Next Generation Core Services (NGCS). However, during the transition period while the Emergency Services infrastructure migrates toward IP, and PSAPs evolve to support i3 functionality, wireline and wireless callers and PSAPs that are served by legacy Selective Routers (SRs), will need to be supported. An LSRG will provide the needed functionality to facilitate emergency call handling during the transition period. Specifically, the LSRG will provide needed functionality to support the following scenarios:

- Emergency call originations that utilize a Selective Router for routing into an i3 ESInet. This includes legacy wireline and wireless originations, as well as Voice over Internet Protocol (VoIP) emergency call originations that are routed via i2 Solution-based VoIP Service Provider (VSP) networks to a legacy SR
- Emergency calls that originate in legacy wireline or wireless networks that are served by ESInets/NGCS, and are destined for a PSAP that is served by a legacy SR
- Emergency calls that originate in i3-compliant originating networks that are served by ESInets/NGCS, and are destined for a PSAP that is served by a legacy SR
- Emergency calls that are transferred between PSAPs served by legacy SRs and i3 PSAPs

The LSRG is a signaling and media connection point between a legacy SR and an i3 ESInet/NGCS. The purpose of the LSRG is to allow PSAPs and origination networks of all types (wireline, wireless, VoIP and Multi-Line Telephone System [MLTS]) to migrate from legacy Emergency Services Networks composed of Selective Routers and Automatic Location Identification (ALI) systems to NG9-1-1 systems consisting of ESInets and NGCS consisting of Emergency Service Routing Proxies (ESRPs), Emergency Call Routing Functions (ECRFs), Location Validation Functions (LVFs), and Location Information Servers (LISs), according to different schedules. The LSRG allows calls routed via a legacy SR to terminate on an i3 PSAP, as well as allowing calls routed via an i3 ESInet to terminate to a legacy PSAP that is connected to a legacy SR. The LSRG also facilitates transfers of calls between PSAPs that are served by legacy SRs and PSAPs that are served by ESInets, regardless of the network from which the call originated.

The LSRG assumes an unmodified SR conformant to NENA 03-005 and an ALI system that supports NENA-STA-015 [6], NENA-STA-027 [7], NENA 04-005 [8] and NENA-STA-018.2-2021 [5] interfaces. It assumes the ESInet/NGCS, as well as the origination networks and PSAPs connected to the ESInet/NGCS, are compatible with/conformant to NENA-STA-010.3 [43]. The LSRG uses the tandem-to-tandem features described in NENA 03-003 [3] to interwork calls between the SR and the ESInet/NGCS. To the ESInet/NGCS, the LSRG appears to be a Legacy Network Gateway (LNG) for incoming emergency calls. The LSRG looks to the ESInet/NGCS like a Legacy PSAP Gateway (LPG) for emergency calls that are destined for legacy PSAPs that are served by Selective Routers. To the Selective Router, the LSRG appears to be a tandem SR. To the ALI system, the LSRG may appear as a PSAP, using a conventional ALI query interface, or as a Mobile Positioning Center (MPC)/Gateway Mobile Location Center (GMLC) or VoIP Positioning Center (VPC), connected via an E2 interface.

Transition using an LSRG assumes the existence of an ESInet with the core capabilities (i.e., NG9-1-1 Core Services [NGCS]) described in NENA-STA-010.3 [43] and, in all likelihood, one or more conformant i3 PSAPs[1]. Assuming such a transitional architecture, emergency calls would originate through the SR, and those intended for, or transferring to, an i3 PSAP would transit the LSRG. Over time, it is expected that origination networks will interconnect with the ESInet/NGCS either directly, by implementing i3 interfaces, or by connecting via an LNG. Emergency calls from such origination networks would be routed via the i3 ESInet and delivered either directly to i3 PSAPs, or to legacy PSAPs either via an LSRG (for PSAPs still served by SRs) or via an LPG.

This document provides a complete technical standard for the LSRG with examples illustrating its role in the processing of emergency call originations and transfers included herein. Since the LSRG sits between a standards-compliant SR/ALI and standards-compliant ESInet/ESRP/ECRF/LVF/LIS, this standard, together with the standards enumerated above, provide a complete standards-based transition to NG9-1-1 per the NENA NG9-1-1 Transition Plan described in NENA-INF-008.1 [9].

[1] The mechanisms described in this document will also support transitional architectures that include originating networks that are served by legacy SRs and PSAPs that are served by legacy SRs with an i3 ESInet in the middle, as well as arrangements where there are no i3 PSAPs and one or more i3 compliant origination networks.

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NENA-STA-034.1-2022	03/17/2022	Initial Document

2 Architecture

As shown in Figure 1, an LSRG is a signaling and media interconnection point for calls routed between a legacy E9-1-1 system and the i3 architecture. The LSRG logically resides between the legacy E9-1-1 network and the ESInet/NGCS and allows i3 PSAPs to receive emergency calls from legacy originating networks connected to an SR. It allows PSAPs connected to an SR to receive calls from originating networks connected to the ESInet/NGCS. It also facilitates call transfer between i3 PSAPs and legacy PSAPs that are served by an SR.

An emergency call that is routed from an originating network (Orig Network B) via an ESInet/NGCS and is destined for a legacy PSAP (Legacy PSAP A) that is connected to an SR must traverse an LSRG on the egress side of the ESInet/NGCS.

An emergency call that is routed from an originating network (Orig Network A) via a Selective Router and is destined for an i3 PSAP that is connected to an ESInet/NGCS must traverse an LSRG on the ingress side of the ESInet/NGCS.

Calls that are transferred between an i3 PSAP and a Legacy PSAP (Legacy PSAP A) must traverse an LSRG.

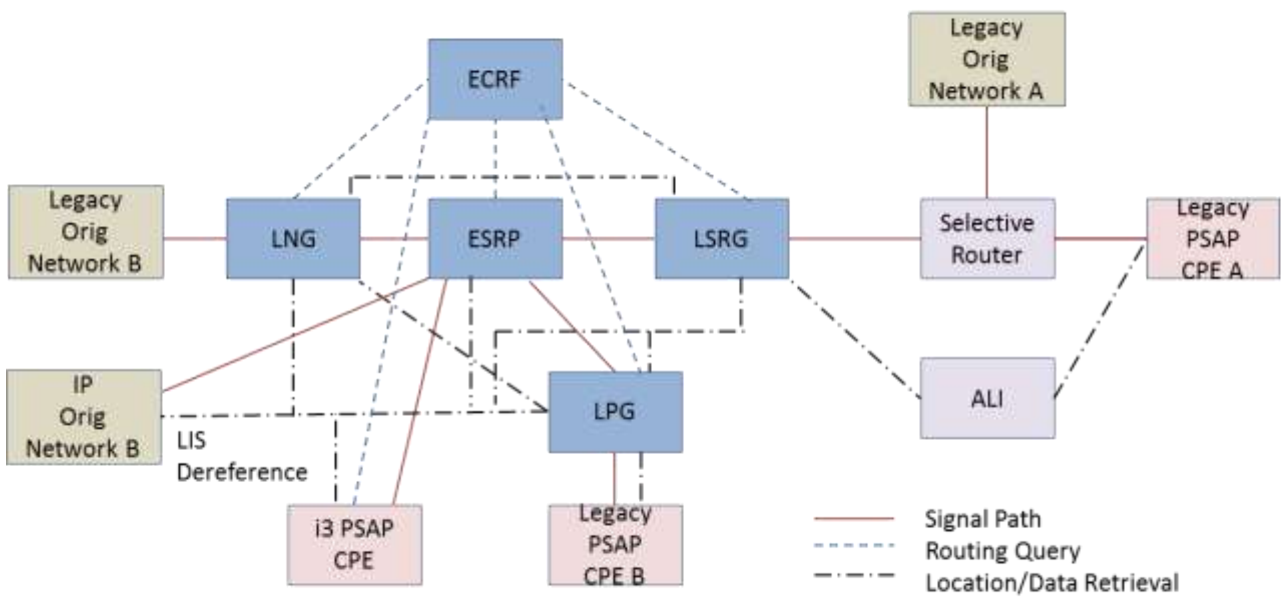

Figure 1 – High Level Transition Architecture

2.1 Detailed LSRG Functional Architecture

The placement of the LSRG in the transitional architecture, and the functional components that make up the LSRG are illustrated in Figure 2.[2] For ease of discussion, Figure 2 shows an LSRG in an ingress configuration on the left side of the diagram. The ingress LSRG facilitates the delivery of calls from a legacy E9-1-1 Network to an ESInet/NGCS. The diagram also shows an LSRG in an egress configuration on the right side of the diagram. The egress LSRG facilitates the delivery of calls from an ESInet/NGCS to a legacy E9-1-1 Network. This is strictly to facilitate the discussion regarding the functionality of the LSRG, and not intended to imply that there are two types of LSRGs.

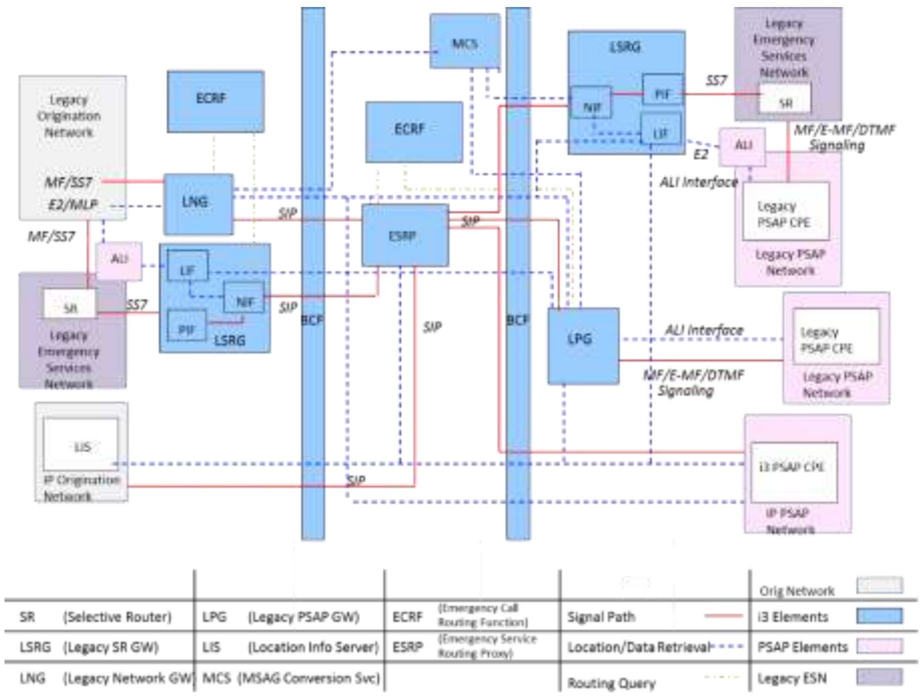

Figure 2 – Transitional Architecture Including LSRGs

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[2] Note that the functional decomposition of the Legacy Selective Router Gateway described in this section is provided to assist the reader in understanding the functions and external interfaces that a Legacy Selective Router Gateway must support. Actual implementations may distribute the functionality required of the Legacy Selective Router Gateway differently among functional components, as long as all of the functions and external interfaces described herein are accounted for.

2.1.1 LSRG Ingress Configuration

The ingress LSRG is shown on the left side of Figure 2. Calls originating in the E9-1-1 network must undergo signaling interworking to convert the incoming Signaling System Number 7 (SS7) signaling used by the SR to the Session Initiation Protocol (SIP)-based signaling supported by the ESInet/NGCS. Thus, an LSRG on the ingress side of the ESInet supports a physical SS7 interface on the SR side, and an IP interface which produces SIP signaling towards the ESInet/NGCS. Therefore, the LSRG must provide the protocol interworking functionality from the SS7 signaling that it receives from the SR to the SIP signaling used in the ESInet/NGCS.

The LSRG is also responsible for routing emergency calls originating from a network connected to the SR to the appropriate ESRP on the ESInet. In other words, the SR selectively routes emergency calls to the LSRG, and the LSRG "selectively routes" those calls to the correct ESRP. To support this routing, the LSRG must apply specific interwork functionality to legacy emergency calls that will allow the information provided by the wireline switch or Mobile Switching Center (MSC) (e.g., calling number/Automatic Number Identification (ANI), Emergency Services Routing Key [ESRK], cell site/sector represented by an Emergency Services Routing Digits [ESRD]) in the call setup signaling, and passed to the LSRG through the SR, to be used as input to the retrieval of routing and caller location. The LSRG obtains caller location information by querying a legacy ALI database using the "key" (i.e., calling number/ANI, ESRK, ESRD) provided in call setup signaling. The LSRG obtains routing location either from the ALI database (e.g., for wireline originations) or by mapping the received ESRK/ESRD to a location that is representative of the target PSAP's serving area. (See Section 3.3.1 for further details.) The LSRG uses the routing location to query an ECRF to obtain routing information in the form of a Uniform Resource Identifier (URI). The LSRG must then forward the call/session request to an ESRP on the ESInet, using the URI provided by the ECRF. The LSRG will include callback and location information in the outgoing SIP signaling sent to the ESRP.

2.1.2 LSRG Egress Configuration

The egress LSRG is the one shown on the right side of Figure 2. An emergency call that is routed via an ESInet/NGCS and is destined for a legacy PSAP that is connected to an SR must traverse an LSRG on the egress side of the ESInet/NGCS. To ensure that the LSRG delivers the call to the SR that serves the target PSAP, the LSRG maintains a mapping between the PSAP URI delivered to it in incoming SIP signaling (after being obtained by an ESRP from the ECRF) and the Directory Number (DN) of the corresponding PSAP on the SR. The LSRG uses the PSAP DN to select the outgoing route to the appropriate SR and delivers the emergency call to the SR over an SS7-supported tandem-to-tandem trunk group. The SR then uses the PSAP DN to deliver the call to the correct PSAP.

2.1.3 Call Transfers Using the LSRG

Similar mechanisms are provided for transfers of calls from the ESInet to the SR and vice versa. As described in more detail in Section 3.2.1.2, for emergency calls that are transferred from a PSAP that is served by an SR to a PSAP that is served by an ESInet/NGCS, the LSRG will be responsible for using the pseudo-Automatic Number Identification (pANI) received in incoming signaling from the SR (which will mirror the pANI created by the LSRG during the processing of the original emergency call) to identify the location and callback information associated with the original emergency call, and then populating that information in an Emergency Incident Data Object (EIDO) for delivery to the transfer-to PSAP. Calls transferred from a PSAP that is served by an ESInet to a PSAP that is served by a legacy E9-1-1 network must also undergo processing at an LSRG to ensure that location information is converted into a format that can be used by the legacy E9-1-1 network. For example, in transferring emergency calls from a PSAP that is served by an ESInet to a PSAP that is served by a legacy E9-1-1 network, the LSRG will have to support queries from legacy ALI systems for callback number and location information. (See Section 3.3.3 for further details.)

2.1.4 Data Retrieval

In addition to supporting call delivery, the LSRG must also support location retrieval/interwork functionality. For calls that traverse an SR on the ingress side of the ESInet/NGCS, the LSRG must determine a routing location and caller location for the call. The LSRG will use the routing location as input to i3 routing mechanisms, and will deliver the routing location to the ESInet. The LSRG will also play a role in delivering the caller location to the PSAP. (See Section 3.3.1 for further details.)

For emergency calls that are routed via the ESInet and answered at, or transferred to PSAPs that are served by a legacy E9-1-1 network, the LSRG assigns a pANI to the call that can be delivered via the SR to the target PSAP, and used by the PSAP to query the ALI system. The ALI system steers the location query to the LSRG over an E2 connection. The LSRG uses the i3 location mechanisms to obtain the location associated with the pANI, and includes the caller location in the E2 response. (See Section 3.3.3 for further details.)

2.1.5 Support for Teletypewriter (TTY) Calls

As described in NENA-STA-010.3 [43], while it is expected that deaf and hard of hearing callers will migrate from using Teletypewriter (TTY) devices to other forms of communication including RFC 4103 [10]-based Real Time Text (RTT), during transition to NG9-1-1 there will be a need to support transcoding between Baudot and RFC 4103 [10] Real Time Text. See *Emergency Access Advisory Committee (EAAC) report on TTY transition* [22] for background and *Emergency Access Advisory Committee (EAAC) Report* *on procedures for calls between TTY users and NG9-1-1 PSAPs* [23] and *Emergency Access Advisory Committee (EAAC) Proposed procedures for the TTY as a text terminal in legacy 9-1-1 PSAPs without IP connection* [24] for specific procedures. Ingress and egress LSRGs will be required to support this transcoding. See Sections 3.1.2, 3.2.1.4, and 3.2.2.4 for further details.

2.1.6 Functional Components of the LSRG

The functional components that comprise the LSRG are described below:

1. (SS7 to SIP) Protocol Interworking Function (PIF). For LSRGs on the ingress side of an i3 ESInet, this functional component performs a standard interworking function that converts the incoming SS7 protocol from the legacy SR to the SIP protocol expected by the i3 ESInet/NGCS and also converts the incoming Time Division Multiplexing (TDM) voice to the Real-time Protocol (RTP) data required by the i3 ESInet/NGCS. If the incoming call is a TTY call, the PIF will be responsible for interworking TTY to RFC 4103 [10] Real Time Text per RFC 5194 [33]. For LSRGs on the egress side of an i3 ESInet, this functional component performs standard interworking from the SIP signaling provided to it by the i3 ESInet to outgoing SS7 signaling, and incoming RTP to outgoing TDM. If an incoming call is to be delivered by the LSRG via an SR to a legacy PSAP as a TTY call, the PIF component will be responsible for recognizing the media format provided in the Session Description Protocol (SDP) as being associated with Real Time Text and generating Baudot tones for delivery to the legacy PSAP. If a legacy PSAP responds to an incoming call by generating Baudot tones, the PIF component will be responsible for recognizing the Baudot tones in incoming media and replacing them with RFC 4103 [10] Real Time Text.[3] (See Section 3.1.2 for further details.)
2. NG9-1-1-specific Interwork Function (NIF). This functional component provides NG9-1-1-specific processing of the incoming call signaling, which includes identification or generation of the 10-digit key(s) (e.g., calling number/ANI, ESRK, ESRD) that will be used as part of location interworking. (See below for further information regarding the Location Interwork Function [LIF] functional component of the Legacy Selective Router Gateway.) For an incoming emergency call from an SR, the location information is retrieved from the LIF, and the NIF functional component provides the means by which the address of the target ESRP is identified (i.e., via a query to the ECRF), and the route to that ESRP is selected. For

[3] The functionality provided by the PIF component can be implemented using a commercially available gateway system.

a call delivered to the LSRG by the ESInet, the location information is obtained from the incoming SIP signaling and supplied to the LIF. The egress LSRG generates a pANI to be used with the call and associates it with the incoming location information.

For ingress LSRGs, this functional component also includes the ability to select a default route if necessary to the ESInet. Having identified the route to the ESRP, the NIF is also responsible for forwarding the request to the ESRP and including location (or a location reference) and callback information in the outgoing signaling. For egress LSRGs, the NIF is responsible for selecting the route to the appropriate SR and including the pANI that it generated and/or callback information in SIP signaling to the PIF component. As described above, the PIF component will then interwork that SIP signaling to outgoing SS7 signaling for delivery to the SR.

The NIF component of an ingress LSRG is also responsible for taking any non-location call information (e.g., class of service) provided by the LIF and either generating a data structure that contains additional data about the call, along with a pointer/reference to that data structure, or providing the non-location additional call information "by value" in outgoing SIP signaling. The NIF component of an egress LSRG will pass the additional call data (by-value or by-reference) from incoming signaling to the LIF for it to use in populating an ALI response. (See Section 3.2 for further details.)

For TTY originations, or calls delivered to legacy PSAPs as TTY calls, the NIF component facilitates the "turn-taking" expected by the TTY users involved in a conversation between an emergency caller and a legacy PSAP. (See Section 3.2.1.4 for further discussion.)

3. Location Interwork Function (LIF). In an ingress LSRG, this functional component is responsible for taking the appropriate location key(s) from the incoming signaling (e.g., calling number/ANI, ESRK, ESRD, Emergency Services Query Key [ESQK]), provided to it by the NIF, and using the keys to retrieve location information via the ALI, and where applicable, static mapping tables.[4] The routing location information is provided to the NIF for use in determining the route for the emergency call, and for populating the outgoing signaling messages. The caller location is retained in anticipation of queries from the PSAP/LPG/egress LSRG. Other non-location

[4] Note that, in the case of certain legacy wireless emergency call originations, the location server/database will need to query an element in the legacy wireless network (i.e., an MPC/GMLC) to obtain location information associated with the emergency call.

information associated with the call that is known/obtained by the LIF will be passed to the NIF for forwarding or population in an Additional Data structure.

For egress LSRGs, the LIF component will be responsible for taking location information (location-by-value [LbyV] or location-by-reference [LbyR]) provided to it by the NIF and reformatting it as appropriate for delivery to the ALI in an E2 response. If the location provided by the NIF is LbyR, the LIF will first initiate a de-reference request to obtain the location-by-value. The LIF in an egress LSRG will also include non-location call information provided to it by the NIF component in the E2 response that it generates. If the non-location call data is provided by the NIF "by-reference", the LIF will query the Additional Data Repository (ADR) using the pointer/reference provided in incoming signaling from the NIF to obtain the Additional Data "by-value". (See Section 3.3 for further details.)

Section 3 describes each of the functional components of the Legacy Selective Router Gateway in detail.

3 Functional Description

3.1 Protocol Interworking Function (PIF)

The LSRG is responsible for providing signaling connectivity between a legacy SR and an i3 ESInet/NGCS. Specifically, this means that the PIF component of the LSRG is expected to support Signaling System No. 7 (SS7) trunking arrangements and is responsible for mapping information received in incoming Signaling System No. 7 (SS7) signaling from a legacy SR to outgoing SIP signaling as appropriate for the interconnecting ESRP, and incoming SIP signaling from an ESRP to the SS7 signaling supported by a legacy SR.

3.1.1 SS7 Interface

When an LSRG on the egress side of an ESInet/NGCS determines that an SS7 Initial Address Message (IAM) associated with a 9-1-1 call is to be generated, it SHALL generate and pass Message Transfer Part (MTP)-level information, along with the Integrated Services Digital Network User Part (ISUP) information, to the Legacy SR.

3.1.1.1 SS7 Message Transfer Part (MTP) Signaling for 9-1-1 Call Setup

A legacy SR that serves the originating network and an LSRG on the egress side of an ESInet will be responsible for populating the Signaling Information Field (SIF) and the Service Information Octet (SIO) portions of the IAM that is sent by a legacy SR to an ingress LSRG, or by an egress LSRG to a legacy SR that is serving the target PSAP.

The SIO contains the service indicator that identifies the MTP-user part involved in the message. In the case of a call setup message generated by a legacy SR, the service indicator identifies the ISDN User Part as the MTP user. The subservice field indicates that the message is a national network message and identifies the MTP message priority. In the case of IAMs related to 9-1-1 calls, the message priority has the value "1" (where priority 3 is the highest priority assigned to SS7 messages). Note that the MTP message priority does not determine which messages are processed first when received at a node, but is used instead to determine which messages should be discarded if the SS7 network experiences congestion.

The SIF contains a routing label, consisting of the Originating and Destination Point Codes, as well as the Signaling Link Selection value for the message, a Circuit Identification Code associated with the trunk selected for the call, a Message Type Code identifying the message as an IAM, and the content of the IAM itself.

For incoming calls from legacy SRs, the SR is expected to provide this information, along with the ISUP information described below, to the LSRG.

For outgoing calls from the LSRG to a legacy SR, the LSRG SHALL populate the following information in the MTP SIO associated with the outgoing IAM:

- The service indicator populated by the PIF component of the egress LSRG SHALL identify the ISDN User Part as the MTP user
- The subservice field populated by the PIF component of the egress LSRG SHALL indicate that the message is a national network message and that the message priority has a value of "1."

For outgoing calls from the LSRG to a legacy SR, the PIF component of the egress LSRG SHALL populate the following information in the MTP SIF associated with the outgoing IAM:

- A routing label that contains the point code of the LSRG in the Originating Point Code field, the point code of the legacy SR in the Destination Point Code field, and a Signaling Link Selection (SLS) code assigned by the LSRG.
- A Circuit Identification Code assigned by the LSRG and associated with the trunk selected for the call.
- A Message Type code identifying the message as an IAM.
- The content of the IAM itself.

Further details related to MTP message structure can be found in GR-246-CORE, Chapter T1.110.1, Section 5.1 and Chapter T1.111.3, Section 2.

3.1.1.2 SS7 ISUP Signaling Associated with Incoming Call Originations from Legacy SRs (Ingress LSRG Function)

For wireline originations received by a legacy SR and routed to the LSRG, the PIF component of the ingress LSRG SHALL be capable of receiving and processing an ISUP IAM containing parameters populated as described in GR-2956-CORE, *CCS/SS7 Generic Requirements in Support of E9-1-1 Service* [51], Section 5.2.2.1, R2956-84, with the following exception: the address signals in the Called Party Number parameter shall be coded with the digits "9-1-1," the nature of address indicator within the Called Party Number parameter shall be coded "0000011" for "national (significant) number," and the numbering plan shall be coded "001" for "ISDN (Telephony) numbering plan (E.164). The IAM is also expected to contain a 10-digit Calling Party Number, and optionally, a 10-digit Charge Number.

For wireless originations received by a legacy SR and routed to the LSRG, the PIF component of the ingress LSRG SHALL be capable of receiving and processing an ISUP IAM containing parameters populated as described in GR-2956-CORE, Section 5.2.2.3, R2956-86, with the following exception: the address signals in the Called Party Number parameter shall be coded with the digits "9-1-1," the nature of address indicator within the Called Party Number parameter shall be coded "0000011" for "national (significant) number," and the numbering plan shall be coded "001" for "ISDN (Telephony) numbering plan (E.164)." As described in ANSI J-STD-036-C-2, wireless calls may be delivered to a legacy SR using one of two approaches: Wireline Compatibility Mode (WCM) or Non-Call Associated Signaling (NCAS). When WCM is used, only an ESRK is signaled as the Automatic Number Identification (ANI)/Calling Party Number over the dedicated trunk group to the legacy SR. When NCAS is used, both an ESRD and the Mobile Directory Number (MDN) are signaled over the dedicated trunk group to the legacy SR. The mechanism used to deliver wireless emergency calls to a legacy SR is based on agreements between the Wireless Service Provider (WSP) and the E9-1-1 System Service Provider (SSP), and is reflected in provisioning associated with the incoming trunk group. Consistent with GR-2956-CORE, the PIF component of an ingress LSRG SHALL receive the calling party number or an ESRK populated in the Calling Party Number parameter, and possibly also the Charge Number parameter, of the incoming IAM. If a callback number is received in the Calling Party Number parameter of the incoming IAM, the LSRG SHALL also receive an ESRD populated in the Generic Digits Parameter (GDP).[5]

[5] In some existing implementations, legacy SRs may receive an ESRK signaled in the SS7 GDP and a calling party number in the SS7 Calling Party Number parameter. The LSRG must therefore also be capable of receiving an IAM with this information based on provisioning associated with the incoming trunk group.

The above signaling procedures for Wireline Compatibility Mode (WCM) wireless emergency call originations (where the ESRK is signaled in the SS7 Calling Party Number parameter) also apply to VoIP emergency call originations that are routed to a legacy SR via an i2-based VoIP Service Provider network. For VoIP emergency call originations, the ESQK replaces the ESRK. As specified in NENA 08-001 Version 2 [52], i2 VoIP originations may result in both the ESQK and the callback number being signaled to the SR. To support these arrangements, the LSRG MUST be capable of receiving the callback number in the SS7 Calling Party Number parameter and the ESQK in the GDP.

Upon receiving an incoming emergency call from a legacy SR, the PIF SHALL generate a SIP INVITE message which it will pass to the NIF component of the LSRG. The PIF component is expected to use standard interworking procedures to map incoming SS7 parameters to the appropriate fields within the SIP INVITE message it sends to the NIF. See Section 4.1.3 for details related to the encoding of this SIP INVITE message.

In addition to receiving ISUP IAMs from legacy SRs, the PIF component of the LSRG MUST also be capable of generating and receiving subsequent call-related ISUP messages in response to received SIP session-related signaling messages. This includes the ability to generate and return an ISUP Address Complete Message (ACM) upon receipt of a SIP 180 RINGING message, and an ISUP Answer Message (ANM) upon receipt of a SIP 200 OK message. The ISUP ACM generated by the PIF component of the LSRG SHALL be formatted as described in Section 7.2.1.1 of ATIS-1000679.2015 [20], and Section 3.1.1.5 of GR-317-CORE [45], with the following clarification. It is expected that bits DC of the Backward Call Indicator parameter SHALL be set to "01" indicating "subscriber free," bits HG of the Backward Call Indicator parameter SHALL be set to "00" indicating "no end-to-end method available," bit I SHALL be set to "1" indicating "interworking encountered" bit K SHALL be set to "0" indicating "ISDN User Part not used all the way," and bit M SHALL be set to "0" indicating "terminating access non-ISDN."

The PIF component of the LSRG SHALL be capable of receiving and processing a SIP 200 OK message from the NIF component, indicating that the call has been answered. Upon receiving a 200 OK message from the NIF, the PIF SHALL generate an ISUP ANM formatted as described in Section 3.1.1.6 of GR-317-CORE [45]. If the ANM is the first backward message sent by the LSRG (i.e., no ACM was previously sent due to the 200 OK being the first SIP message received), the PIF component of the LSRG SHALL follow the procedures specified in Section 7.5.1 of ATIS-1000679.2015 [20]. Specifically, the Called Party's Status indicator (Bit DC) of the Backward Call Indicators parameter SHALL be set to "no indication," bit I SHALL be set to "1" indicating "interworking encountered," bit K SHALL be set to "0" indicating "ISDN User Part not used all the way," and bit M SHALL be set to "0" indicating "terminating access non-ISDN."

In addition, the PIF component of the LSRG SHALL be capable of receiving an ISUP Release (REL) message from a legacy SR, and returning an ISUP Release Complete (RLC), formatted as described in Table A-6 of GR-317-CORE [45] in response, as well as generating a SIP BYE message and sending it to the NIF component of the ingress LSRG. The PIF component of the ingress LSRG SHALL also be capable of sending a REL to the legacy SR in response to receiving a SIP BYE message from the NIF component, formatted as described in Table A-5 of GR-317-CORE [45], and receiving a RLC from a legacy SR in response.

The PIF component of the LSRG SHALL be capable of receiving and processing supervisory ISUP messages sent by a legacy SR (e.g., Blocking, Blocking Acknowledgement). The PIF component SHALL follow the procedures described in Section 3.1.4 of GR-317-CORE [45] for processing these messages.

3.1.1.3 SS7 ISUP Signaling Associated with Emergency Calls Routed via an ESInet to a PSAP Served by a Legacy SR (Egress LSRG Function)

SS7-supported tandem-to-tandem signaling arrangements, as described in NENA 03-003 [3], will be used to deliver emergency call originations routed via an ESInet/NGCS to PSAPs served by a legacy SR. When an emergency call originates in a legacy or i3-compliant originating network, is routed via the ESInet/NGCS, and is destined for a PSAP that is served by a legacy SR, the PIF component of the egress LSRG SHALL be responsible for interworking the associated SIP signaling received from the NIF component with SS7 signaling to the legacy SR.[6]

In response to the receipt of a SIP INVITE from the NIF associated with an emergency call origination, the PIF component of the LSRG SHALL generate an IAM and send it to the legacy SR.

The IAM SHALL be coded as described in GR-2956-CORE [51], Section 5.2.2.1, R2956-84 with the following clarifications.

- The PIF component SHALL populate the SS7 Called Party Number parameter based on the PSAP number/address received in the Request URI of the incoming INVITE message from the NIF.

[6] The legacy SR is expected to use direct routing (i.e., route the call based on the PSAP number/address received in the SS7 Called Party Number parameter) to deliver the call to the destination PSAP, as described in Section 5.1.2 of NENA 03-003. The SR is also expected to query the Selective Routing Database (SRDB) to obtain the ESN for the call to support Selective Transfer and "flashing ANI" display features.

- The PIF component SHALL populate the SS7 Calling Party Number parameter with the pANI or callback number provided by the NIF in the P-Asserted-Identity header of the received INVITE message.
- The PIF component SHALL populate the Calling Party's Category with the value "emergency service call."
- The PIF component SHALL include the Nature of Connection Indicator, the Forward Call Indicators, the User Service Information parameter, and optionally, the Higher Layer Compatibility information element within the Access Transport Parameter, as described in Section 6.1.3 of ATIS-1000679.2015 [20].
- If the PIF component receives a Geolocation header containing the pANI generated by the NIF component and a Geolocation-Routing header set to "no" in the incoming INVITE message from the NIF component, the PIF component SHALL populate the pANI in an SS7 Generic Digits Parameter, per ATIS-1000679.2015.
- The PIF component SHALL NOT include a Calling Geodetic Location parameter in the outgoing IAM.
- If the PIF component receives a P-Charge-Info header in the SIP INVITE message from the NIF component, the PIF SHALL use the information in the P-Charge-Info header to populate an SS7 Charge Number parameter in the outgoing IAM, per Section 6.1.3.13 of ATIS-10000679.2015. The PIF component SHALL also populate the Originating Line Information parameter in the outgoing SS7 IAM with the value "00000000" per GR-2956-CORE[51].

The PIF component SHALL also generate a 100 TRYING message and send it to the NIF component. (The PIF SHALL follow the procedures in RFC 3261 [13] for populating the outgoing 100 TRYING message.)

In response to the receipt of an SS7 ACM from the legacy SR with the Called Party Status indicator within the Backward Call Indicators set to "subscriber free," the PIF component of the LSRG SHALL generate a 180 RINGING message and send it to the NIF. If the PIF component receives an ACM with a Called Party Status indicator value set to "in-band information or an appropriate pattern is now available", the PIF component of the LSRG SHALL generate a 183 SESSION PROGRESS message and send it to the NIF. (If the PIF component receives an ACM with a Called Party Status indicator value set to something other than "subscriber free" or "in-band information or an appropriate pattern is now available", the PIF component SHALL NOT interwork the message, as described in Section 6.3 of ATIS-1000679.2015. In this event, the system would just wait for an answer indication.) Upon receiving an SS7 ANM from the legacy SR, the PIF component of the LSRG SHALL generate and send a SIP 200 OK message to the NIF component.

The PIF SHALL follow the procedures described in Section 3.1.1.2 for sending/receiving SIP BYE messages and sending/receiving SS7 REL and RLC messages related to emergency call originations that are routed to the LSRG via the ESInet/NGCS.

The PIF component SHALL follow the procedures described in Section 3.1.4 of GR-317-CORE [45] for generating/processing ISUP supervisory messages.

3.1.1.4 SS7 ISUP Signaling Associated with Transferred Emergency Calls Initiated by PSAPs Served by Legacy SRs

Emergency calls transferred between PSAPs served by a legacy SR and i3 PSAPs will utilize an SS7 interface between an LSRG and a legacy SR. For emergency calls transferred from a legacy PSAP via SS7-supported tandem-to-tandem trunk groups between a legacy SR and an LSRG to an i3 PSAP, the PIF component of the LSRG SHALL be capable of receiving an IAM from a legacy SR associated with an emergency transfer request initiated by a PSAP that is served by a legacy SR, coded as described in GR-2956-CORE [51], R2956-48. Specifically, the Called Party Number parameter of the IAM sent from the legacy SR to the LSRG will contain a 10-digit PSAP number/address associated with the transfer-to i3 PSAP. The Calling Party Number and Charge Number will contain the same information as the legacy SR received in an emergency call origination. If a GDP was received by the legacy SR in incoming signaling associated with an emergency call, it will be signaled to the LSRG in a GDP.

Upon receiving an IAM associated with a transferred emergency call, the PIF component SHALL generate a SIP INVITE message and send it to the NIF component. The PIF component SHALL apply standard interworking procedures to map incoming SS7 parameters to the appropriate fields within the SIP INVITE message. See Section 3.1.3 for details related to the encoding of this SIP INVITE message.

The PIF component SHALL apply the procedures described in Section 3.1.1.2 for generating/processing subsequent SS7 messages associated with an emergency transfer request initiated by a PSAP served by a legacy SR.

3.1.1.5 ISUP Signaling Associated with Transferred Emergency Calls Destined for PSAPs Served by Legacy SRs (Egress LSRG Function)

Emergency calls transferred from an i3 PSAP to a legacy PSAP that is served by a legacy SR will also traverse SS7-supported tandem-to-tandem trunk groups between an LSRG and a legacy SR. In this case, the PIF component of the LSRG SHALL be capable of generating an SS7 IAM upon receipt of a SIP INVITE message from the NIF component associated with an emergency transfer request initiated by an i3 PSAP. As in Section 3.1.1.3, the IAM SHALL contain a 10-digit PSAP number/address associated with the transfer-to legacy PSAP in the Called Party Number parameter, either the callback number or the pANI created by the LSRG in an SS7 Calling Party Number parameter, and if a Geolocation header containing a pANI and a Geolocation-Routing header set to "no" was received in the INVITE from the NIF component, a Generic Digits Parameter that contains the pANI (with the callback number in the SS7 Calling Party Number parameter).

The PIF component SHALL apply the procedures described in Section 3.1.1.3 for generating/processing subsequent SS7 and SIP messages associated with an emergency transfer request initiated by an i3 PSAP.

3.1.2 Handling of Media: Support for TTY-RTT Interworking

3.1.2.1 Ingress LSRG

If an ingress LSRG receives an incoming TTY call, the PIF component SHALL be responsible for recognizing the Baudot tones in incoming media and replacing them with RFC 4103 [10] Real Time Text (RTT). Likewise, the PIF component SHALL be responsible for generating Baudot tones (i.e., toward the caller) in outgoing media if Real Time Text is received in RTP packets.

The ingress LSRG SHALL handle a TTY emergency origination by initially establishing an audio session with the i3 PSAP (or Legacy PSAP Gateway or egress LSRG) and subsequently requesting, or processing an incoming request for, the addition of an RFC 4103 [10] text media session as described below.

If an emergency call is delivered to the PSAP as a "silent" call, the ingress LSRG SHALL be capable of receiving and processing a re-INVITE from an i3 PSAP, Legacy PSAP Gateway, or egress LSRG that requests the addition of RFC 4103 [10] text media to the existing emergency session. (See Section 3.1.4.1.2 for further details.)

If the PIF component detects Baudot tones after an audio session is established, and an RFC 4103 [10] text media session has not already been established (via a re-INVITE from an i3 PSAP, Legacy PSAP Gateway, or egress LSRG), the ingress LSRG PIF component SHALL generate a SIP re-INVITE message that includes an offer in the SDP describing a media format associated with Real Time Text (as specified in RFC 4103 [10]), and SHALL send the SIP re-INVITE message to the NIF component. (See Section 3.1.4.1.1 for further details.) The PIF component SHALL buffer any Real Time Text that is converted from the received Baudot tones until such time as the Real Time Text media session is established (i.e., a 200 OK message is received from the NIF component in response to the re-INVITE) and the real-time text can be passed forward.

If the PIF component detects Baudot tones before an audio session is established, the PIF component SHALL wait for the audio session to be established, and if a text session has not already been established, the PIF component SHALL generate a SIP re-INVITE message that includes an offer in the SDP describing a media format associated with real-time text (as specified in RFC 4103 [10]), and send the SIP re-INVITE message to the NIF component. The PIF component SHALL buffer any real-time text that is converted from the received Baudot tones until such time as the Real Time Text media session is established (i.e., a 200 OK message is received from the NIF component in response to the re-INVITE) and the real-time text can be passed forward. (See Section 3.1.4.1.1 for further details.)

When the PIF component translates RFC 4103 [10] Real Time Text received from an i3 ESInet/NGCS (via the NIF component) to TTY, it MUST apply the following character mappings defined in [22] to address limitations in the character sets supported by TTY devices.

- During transmission, the PIF component SHALL check every character for validity in the TTY character set.
- The PIF component SHALL convert upper case to lower case
- The PIF component SHALL support the following translation of the special characters that have no representation in TTY:

RTT	TTY
At sign character “@”	Replace with “(at)”
Octothorpe or hash sign character “#”	Replace with dollar sign character “$”
Percentage character “%”	Replace with slash character “/”
Ampersand character “&”	Replace with plus sign character “+”
Asterisk character “*”	Replace with a period character “.”
Underscore character “_”	Replace with space character “ “
Less than sign character “<”	Replace with left parenthesis character “(“
Greater than sign character “>”	Replace with right parenthesis character “)”
National character	Replace with the closest companion in the a-z character range. e.g., “ñ” => “n”

RTT	TTY
Unknown character[7]	Replace with apostrophe character '

- The PIF component SHALL convert to 5-bit code and add shift character if needed.
- The PIF component SHALL transmit according to TIA-825A [20].

RFC 4103 [10] states that "…common mean character transmission rate, during a complete PSTN text telephony session, is around two characters per second". It also states, "A maximum performance of 20 characters per second is enough even for voice-to-text applications." The EACC Report states, "TTY transmission is only at a speed of around 5 characters per second." A variation between three (3) and six (6) seconds must be allowed for in the transmission of TTY due to the need to insert shift characters when there is a shift between letters and figures. The PIF SHALL send characters as rapidly as allowed by the TTY protocol. If the transmission rate of the incoming RTT characters exceeds the transmission of the outgoing TTY characters, the PIF SHALL buffer the incoming RTT packets as necessary.

If the PIF component of the ingress LSRG receives (i.e., from a legacy PSAP/LPG) simultaneous RFC 4103 [10] real-time text and audio media, and that audio media includes Baudot tones along with other sounds, the PIF component MUST suppress all other audio in the channel so that only the Baudot tones transcoded from the received RFC 4103 [10] text are delivered to the caller for the length of the transmission, with 22 ms of silence before and after the transmission.

3.1.2.2 Egress LSRG

An egress LSRG MUST be capable of handling incoming RTT media and transcoding the text media to TTY Baudot tones for delivery to legacy PSAPs.

If an incoming call is to be delivered by an egress LSRG via an SR to a legacy PSAP as a TTY call, the PIF component SHALL be responsible for recognizing the media format provided in the SDP of the incoming INVITE message from the NIF component as being associated with Real Time Text, and generating Baudot tones for delivery to the legacy PSAP. The PIF component of the egress LSRG shall apply the same character mappings as specified in Section 3.1.2.1 when interworking between RTT and TTY.

[7] Other characters not in the TTY character set.

If a legacy PSAP responds to an incoming call by generating Baudot tones, the PIF component SHALL be responsible for recognizing the Baudot tones in incoming media and replacing them with RFC 4103 [10] Real Time Text.

If the PIF component receives simultaneous RTT and voice media associated with an emergency call, the PIF component MUST notch the audio frequencies used for Baudot tones from the received audio media and then insert the Baudot tones transcoded from the received RFC 4103 [10] text to minimize the distortion of the Baudot tones delivered to the PSAP.

If a caller requests the use of Hearing Carry Over (HCO) or Voice Carry Over (VCO), the PSAP may need to switch between voice and TTY on a single call. The PIF component SHALL map voice received from the PSAP into RTP voice and Baudot tones received from the PSAP into RFC 4103 [10] text.

If an emergency call is presented to the PSAP as a "silent" call (causing the PSAP to generate Baudot tones toward the caller), the PIF component of the egress LSRG MUST, upon detection of the Baudot tones from the PSAP, be capable of generating a re-INVITE message and sending it to the NIF component to request the establishment of a Real Time Text media session over which the RFC 4103 [10] Real Time Text (which the PIF component transcodes from the incoming Baudot tones) can be sent. (See Section 3.1.4.2.1 for further details.) The PIF component SHALL buffer any Real Time Text that is converted from the received Baudot tones until such time as the text media session is established (i.e., until a 200 OK message is received from the NIF component in response to the re-INVITE) and the Real Time Text can be passed forward.

Upon receiving the re-INVITE message from the PIF component, the NIF component SHALL pass the re-INVITE message toward the caller/Legacy Network Gateway/ingress LSRG, as described in Section 3.2.2.2. When the NIF component receives a 200 OK message indicating that the SDP offer associated with real-time text has been accepted, it SHALL pass the 200 OK message to the PIF component. The PIF component SHALL respond by sending an ACK to the NIF component, and the NIF component SHALL send an ACK toward the caller/Legacy Network Gateway/ingress LSRG.

3.1.3 Handling of Media Associated with SMS/MMS[8] and Instant Messaging (Egress LSRG)

An egress LSRG MUST be capable of handling incoming MSRP messages associated with Short Message Service (SMS)/Multimedia Message Service (MMS) and Instant Messaging

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[8] As specified in ATIS J-STD-110.v002 [42], only the text portion of an MMS origination is presented to the ESInet.

(IM) originations, and transcoding the text media to TTY Baudot tones for delivery to legacy PSAPs.

Interworking of SMS/MMS and Instant Messaging (IM) to Message Session Relay Protocol (MSRP) is expected to occur outside the ESInet, but legacy PSAPs that are served by SRs MUST have the capability to accept SMS/MMS/IM text messages that are interworked from MSRP to TTY. Interworking between MSRP and TTY MUST occur within the egress LSRG. MSRP messages are sent in "session mode" where the entire message is sent. The NIF component is responsible for caching the MSRP message and converting it to RFC 4103 [10] Real Time Text for delivery to the PIF component. The PIF component of the egress LSRG MUST convert the RFC 4103 [10] text to TTY for delivery to a legacy PSAP. As specified in Section 3.1.2.2 for RTT, the NIF component SHALL be responsible for maintaining the conventions associated with TTY calling (See Section 3.2.2.4). Upon determining that the call taker has joined the conversation (via receipt of an appropriate preprogrammed or typed message such as "911 GA"), the PIF component of the egress LSRG SHALL convert the Baudot tones to RFC 4103 [10] text characters and send the text characters to the NIF component.

With respect to incoming RFC 4103 [10] text characters received from the NIF component, the PIF component SHALL apply the same mapping to the text characters as described in Section 3.1.2.1 for an RTT message when interworking with Baudot tones sent to the legacy PSAP.

Mapping of the RFC 4103 [10] text characters associated with an MSRP message to TTY and transmission SHALL be done as rapidly as allowed by the sending procedures of TIA-825A [21] at 45.5 bits per second, which results in a speed of around 5 printable characters per second.

3.1.4 SIP Signaling Between the PIF Component and NIF Component of the LSRG

3.1.4.1 Emergency Call Origination (Ingress LSRG Function)

As described in Section 3.1.1.2, the PIF component of an ingress LSRG SHALL generate a SIP INVITE message upon receiving SS7 signaling associated with an incoming emergency call from a legacy SR, and pass the INVITE message to the NIF component of the LSRG.

The SIP INVITE message passed by the PIF component to the NIF component for emergency call originations routed to the LSRG via a legacy SR SHALL contain the following information:

- A Request-URI that contains the digits "9-1-1" (e.g., expressed as a URI in the form sip:<911>@vsp.com;user=phone)

- A To header that contains the digits "9-1-1" (e.g., expressed as a URI in the form sip:911@vsp.com)
- A From header that is populated with one of the following pieces of information:
  - the information signaled in the SS7 Calling Party Number parameter (i.e., the calling number/ANI, ESRK, or ESQK) if no SS7 Generic Digits Parameter was received by the PIF component, or
  - the ESRD/ESRK/ESQK signaled in the SS7 Generic Digits Parameter, if present in the IAM received by the PIF.
- A P-Asserted-Identity (PAI) header that is populated with the information contained in the SS7 Calling Party Number parameter (i.e., calling number/ANI, ESRK, ESQK). In addition, the PAI header will also contain the content of the SS7 Calling Party's Category (CPC) parameter and the Originating Line Information (OLI) parameter, if present in the IAM received by the PIF component, per Section 7.1.3 of ATIS-1000679.2015 [20].
- A P-Charge-Info header that is populated with the information contained in the SS7 Charge Number parameter, if present in the received IAM, per Section 7.1.7 of ATIS-1000679.2015
- A Contact header that contains the trunk group parameters that identify the incoming trunk group from the SR to the LSRG, as defined in RFC 4904 [18].
- A Via header that is populated with the element identifier of the LSRG
- An SDP offer that includes the G.711 codec.
- Other headers, as required by RFC 3261 [13].

The PIF component of the LSRG SHALL be capable of receiving and processing a SIP TRYING (100) message passed to it by the NIF component acknowledging receipt of the INVITE message that was generated by the PIF component.

Subsequent SIP messages exchanged between the PIF component and the NIF component of the LSRG related to an incoming emergency call from a legacy SR SHALL be coded according to RFC 3261 [13], with the following clarification. The NIF SHALL be capable of receiving and sending, and the PIF SHALL be capable of receiving a 180 Ringing message or a 183 Session Progress Message that contains either a "text" or a "urn:emergency:media-feature.tty-interworking" media feature tag.

3.1.4.1.1 SIP Re-INVITE Sent by Ingress LSRG PIF Component to NIF Component

As described in Section 3.1.2.1, if the PIF component of an ingress LSRG detects Baudot tones, and an RFC 4103 [10] text media session has not already been established (via a re-INVITE from an i3 PSAP, Legacy PSAP Gateway, or egress LSRG), the PIF component SHALL generate a SIP re-INVITE message that includes an offer in the SDP describing a media format associated with Real Time Text (as specified in RFC 4103 [10]), and send the SIP re-INVITE message to the NIF component. The re-INVITE message SHALL reference the existing dialog so that the i3 PSAP (or Legacy PSAP Gateway or LSRG, in the case of a legacy PSAP) knows that it is requesting modification of an existing session instead of establishing a new session. The re-INVITE message SHALL include the same information as the original SIP INVITE message generated by the PIF component (as described in Section 3.1.4.1), with the exception that the SDP offer SHALL include Real Time Text, as described in RFC 4103 [10].

The PIF component SHALL wait to receive a 200 OK message from the NIF component indicating that the offer of Real Time Text has been accepted before sending the text media forward. The PIF component SHALL respond to the 200 OK by returning an ACK message.

3.1.4.1.2 SIP Re-INVITE Sent by Ingress LSRG NIF Component to PIF Component to Support "Silent" Calls

The PIF component of an ingress LSRG MUST be capable of receiving and processing re-INVITE messages from the NIF component associated with emergency calls that are presented to the PSAP as "silent" calls. The received re-INVITE message SHALL include an offer of a media format associated with Real Time Text (as described in RFC 4103 [10]). This re-INVITE message SHALL include the following information:

- A Request-URI that contains the URI and trunk group parameters delivered to the NIF component in the Contact header of the initial INVITE message.
- A To header that contains the information signaled in the From header of the original INVITE message (i.e., the information signaled in an SS7 GDP, if present, or the information signaled in the SS7 Calling Party Number parameter).
- A From header that contains the digits "911" expressed as a URI (delivered to the NIF component in the To header of the original INVITE message).
- A Contact header that contains the information signaled to the NIF in the Request-URI of the original INVITE message (i.e., the digits contained in the SS7 Called Party Number parameter [e.g., "911"] expressed as a URI) and either a 'text' or a "urn:emergency:media-feature.tty-interworking" media feature tag.
- A Via header that is populated with a URI associated with the i3 PSAP, Legacy PSAP Gateway, or egress LSRG.
- An SDP offer that includes Real Time Text, as described in RFC 4103 [10] and G.711 audio.

Upon receiving the re-INVITE message from the NIF component, the PIF SHALL respond with a 200 OK message, indicating that it accepts the SDP offer associated with Real Time Text. It SHALL be capable of receiving an ACK from the NIF component in response.

3.1.4.2 Emergency Call Origination (Egress LSRG Function)

As described in Section 3.1.1.3, the PIF component of the egress LSRG MUST be capable of receiving and processing a SIP INVITE message from the NIF component when an emergency call originates in a legacy or i3-compliant originating network, is routed via the ESInet/NGES, and is destined for a PSAP that is served by a legacy SR.

The SIP INVITE message passed by the NIF to the PIF for emergency call originations routed to the egress LSRG via an ESInet/NGES SHALL contain the following information:

- A Request-URI that contains the 10-digit PSAP number/address to which the emergency call is being directed, (i.e., a PSAP URI resolving at the gateway expressed as a tel URI or a sip URI of the form "sip:<TN>@psap1.gateway.com;user=phone", along with the trunk group parameters that identify the outgoing trunk group to the SR
- A To header that contains the digits "911" (e.g., expressed as a URI in the form sip:911@vsp.com)
- A From header that contains the Address of Record provided by an ESRP consisting of:
    - Calling number/ANI (if the call was originated by a legacy wireline caller)
    - The callback number obtained via the LIF component of the LNG (if the call was originated by a wireless caller via the LNG using a Wireline Compatibility Mode [WCM] arrangement)
    - The callback number received by the LNG in incoming signaling from the legacy originating network (if the call was originated by a wireless caller via the LNG using a Non-Call Associated Signaling [NCAS] arrangement)
    - The callback number associated with an i2 VoIP user/device obtained by the LNG based on incoming signaling or as a result of interactions between the LIF component of the LNG and the VPC (if the call was originated via the LNG by a user served by an i2-based VoIP Service Provider network)

      Note: Under certain circumstances (i.e., where callback information is not available at the time that the initial INVITE message is sent by the LNG to the ESRP), the From header may contain an ESRK/ESQK.
    - The callback number/address associated with the VoIP user/device that originated the emergency call from an i3-compatible originating network
- A P-Asserted-Identity header that either contains the callback number (if both a callback number and a pANI associated with the location are to be delivered to the SR, and the callback number is in the form of or easily converted to a 10-digit North American Numbering Plan [NANP] number) or a "pseudo callback number" generated by the NIF component in the range NPA-511-8950 through NPA-511-8999

(if the Numbering Plan Area [NPA] is one of 281, 405, 806, 870, and 903) or in the range NPA-211-9950 through NPA-211-9999 (for any other NPA). (See Section 3.2.2.1 for further information regarding generation of pseudo callback numbers.) The P-Asserted-Identity (P-A-I) header will also contain a cpc parameter set to "emergency service call", depending on the signaling expected by the target SR.

If only a pANI associated with the location information received in the SIP INVITE from the ESRP is to be delivered to the SR, it will be populated in the P-Asserted-Identity header of the SIP INVITE message sent by the NIF component to the PIF component. The value of the pANI will be derived as described in Section 3.2.2.1.

- If the SR expects to receive both a callback number and a pANI over the interface from the LSRG (as determined by provisioning), the SIP INVITE sent by the NIF component to the PIF component will also include:
    - A Geolocation header containing either the location reference URI received in the Geolocation header from the ESRP (if the location reference URI is of a form that can be easily converted to a 10-digit NANP number, i.e., "+1NPANXXXXXX" , where the NPA-NXX-XXXX portion of the location reference URI is used as the pANI for the call), or a pANI (of the same form described above for the pseudo callback number in the P-Asserted-Identity header) generated by the NIF component (see Section 3.2.2.1 for further details), and
    - A Geolocation-Routing header set to "no"

  Note that the NIF component will not include a Geolocation header or Geolocation-Routing header in the SIP INVITE sent to the PIF if the SR only expects to receive a pANI over the interface from the LSRG.

- A Via header that is populated with the element identifier for the LSRG
- A Record Route header containing an ESRP URI, if present in the SIP INVITE received from the ESRP.
- A Contact header that contains the same information as was received by the NIF component of the LSRG
- An SDP offer that will be the same as received by the LSRG.
- Other headers as required by RFC 3261 [13].

Subsequent SIP messages (e.g., 100 TRYING, 183 SESSION PROGRESS, 180 RINGING, 200 OK, BYE, ACK) returned by the PIF component of the egress LSRG to the NIF component in response to a SIP INVITE message associated with an emergency origination SHALL be coded as described in RFC 3261 [13].

3.1.4.2.1 SIP Re-INVITE Sent by Egress LSRG PIF Component to NIF Component

If an emergency call is presented to the PSAP as a "silent" call, (causing the PSAP to generate Baudot tones toward the caller), the PIF component of the egress LSRG SHALL generate a re-INVITE message (upon receipt of the Baudot tones from the PSAP) and send it to the NIF component to request the establishment of a Real Time Text media session over which the RFC 4103 [10] Real Time Text transcoded from incoming Baudot tones can be sent. The re-INVITE message generated by the PIF component of the egress LSRG SHALL include the following information:

- A Request-URI that contains a URI populated based on the content of the Contact header received in the initial INVITE message.
  - If the initial emergency call was routed to the LSRG via a network that has implemented the transfer procedures described in Section 4.7.1.1 of NENA-STA-010.3, the Request-URI SHALL contain a URI that is associated with the Legacy Network Gateway, ingress LSRG, or caller.
  - If the initial emergency call was routed to the LSRG via a network that has implemented the transfer procedures described in Section 4.7.1.2 of NENA-STA-010.3, the Request-URI SHALL contain a URI that is associated with the Back-to-Back User Agent (B2BUA).
  - If the initial emergency call was routed to the LSRG via a network that has implemented the Answer All Calls at a Conference Aware UA/Bridge model (see Section 4.7.1.3 of NENA-STA-010.3), the Request-URI SHALL contain a URI that is associated with the Conference Aware UA/Bridge.
- A To header that contains the information delivered to the egress LSRG in the From header of the original INVITE message.
- A From header that contains the digits "911" expressed as a URI (received in the To header of the original INVITE message).
- A Contact header that contains the content of the Request-URI provided in the initial INVITE message (i.e., a PSAP URI resolving at the gateway expressed as a tel URI or a sip URI of the form "sip:<TN>@psap1.gateway.com;user=phone"), along with the trunk group parameters that identify the outgoing trunk group to the SR.
- A Via header that is populated with a URI associated with the egress LSRG.
- An SDP offer that includes Real Time Text, as described in RFC 4103 [10] and G.711 audio.

Upon receiving the re-INVITE message from the PIF component, the NIF component SHALL pass the re-INVITE message toward the caller/Legacy Network Gateway/ingress LSRG, as described in Section 3.2.2.2. When the NIF component receives a 200 OK message indicating that the SDP offer associated with Real Time Text has been accepted, it

SHALL pass the 200 OK message to the PIF component. The PIF component SHALL respond by sending an ACK to the NIF component, and the NIF component SHALL send an ACK toward the caller/Legacy Network Gateway/ingress LSRG.

3.1.4.3 Transferred Emergency Calls (Legacy PSAP Served by an SR to i3 PSAP) (Ingress LSRG Function)

As described in Section 3.1.1.4, the PIF component SHALL generate SIP INVITE messages associated with emergency calls that are transferred by a legacy PSAP that is served by a legacy SR to an i3 PSAP.

The SIP INVITE message passed by the PIF component to the NIF component for a transferred emergency call from a PSAP that is served by a legacy SR to an i3 PSAP SHALL contain the following information:

- A Request-URI that contains the 10-digit number/address associated with the transfer-to PSAP, formatted as a URI
- A To header that contains the 10-digit number/address associated with the transfer-to PSAP, formatted as a URI
- A From header that is populated with one of the following pieces of information:
    - The information signaled in the SS7 Calling Party Number parameter (i.e., the calling number/ANI) if no SS7 Generic Digits Parameter was received by the PIF component
    - The pANI signaled in the SS7 Generic Digits Parameter, if present in the IAM received by the PIF
- A P-Asserted-Identity (PAI) header that is populated with the information contained in the SS7 Calling Party Number parameter (i.e., calling number/ANI or pANI). In addition, the PAI header will also contain the content of the SS7 Calling Party's Category (CPC) parameter and the Originating Line Information (OLI) parameter, if present in the IAM received by the PIF component, per ATIS-1000679 [20].
- A P-Charge-Info header that is populated with the information contained in the SS7 Charge Number parameter, if present in the received IAM, per ATIS-1000679
- A Contact header that contains the trunk group parameters that identify the incoming trunk group from the SR to the LSRG, as defined in RFC 4904 [18].
- A Via header that is populated with the element identifier of the LSRG
- An SDP offer that includes the G.711 codec, as well as a media format associated with RTT (if a text media session is associated with the emergency call)
- Other headers, as required by RFC 3261 [13].

Subsequent SIP messages (e.g., 100 TRYING, 180 RINGING, 200 OK, BYE, ACK) received by the PIF in response to a SIP INVITE associated with transferred emergency calls that are routed to the LSRG via an SR that is serving a legacy PSAP SHALL be coded as described in RFC 3261 [13], with the following clarification. The NIF component SHALL include media feature tag information in the subsequent message returned to the PIF component if it receives such information in the associated message from the ESInet/NGCS.

3.1.4.4 Transferred Emergency Calls (i3 PSAP to Legacy PSAP served by an SR)(Egress LSRG Function)

As described in Section 3.1.1.5, the NIF component SHALL generate SIP INVITE messages associated with emergency calls that are transferred by i3 PSAPs to PSAPs that are served by a legacy SR.

The SIP INVITE message passed by the NIF component to the PIF component for a transferred emergency call from an i3 PSAP to a PSAP that is served a legacy SR SHALL contain the following information:

- A From header that contains the conference URI associated with the transferred call (if the transfer models described in Sections 4.7.1.1 or 4.7.1.2 of NENA-STA-010.3 [43] are implemented) or the callback URI (if the transfer model described in Section 4.7.1.3 of NENA-STA-010.3 is implemented)
- A To header that contains the 10-digit number/address associated with the transfer-to PSAP, expressed as a URI (e.g., sip:psapTN@example.com;user=phone) (if the transfer models described in Sections 4.7.1.1 or 4.7.1.2 of NENA-STA-010.3 are implemented) or the digits "911" expressed as a URI or "urn:service:sos" (if the transfer model described in Section 4.7.1.3 of NENA-STA-010.3 is implemented)
- A Request-URI that contains the 10-digit number/address associated with the transfer-to PSAP, expressed as a URI (e.g., sip:psapTN@example.com;user=phone)
- A P-Asserted-Identity header that either contains the callback number or a pANI generated by the NIF component, as described in Section 3.2.2.1 (depending on the signaling supported by the target SR), in the form of a URI
- If the SR expects to receive both a callback number and a pANI over the interface from the LSRG, the SIP INVITE sent by the NIF component to the PIF component will include the callback number in the P-Asserted-Identity header and will also contain:
    - A Geolocation header containing a pANI derived by the NIF component from the location URI received in the EIDO from the i3 PSAP, or generated by the NIF component using the procedures described in Section 3.2.2.1, and
    - A Geolocation-Routing header set to "no"
- A Record Route header containing the URI associated with the conference bridge
- A Via header identifying the LSRG
- A Contact header that contains the conference URI

- An SDP offer that includes the G.711 codec as well as a media format associated with RTT, if a text media session is associated with the emergency call
- Other headers as required by RFC 3261 [13].

Subsequent SIP messages (e.g., 100 TRYING, 183 SESSION PROGRESS, 180 RINGING, 200 OK, BYE, ACK) passed by the PIF component in an egress LSRG to the NIF component associated with transferred emergency calls initiated by i3 PSAPs that are routed to the Legacy SR Gateway via the ESInet/NGES SHALL be coded as described in RFC 3261 [13].

3.2 NG9-1-1 specific Interwork Function (NIF)

The NIF component of an ingress LSRG is expected to provide special processing of the information received in the incoming INVITE message from the PIF component to facilitate call delivery to an i3 ESInet/NGCS. The routing determination capability performed by a NIF component in an ingress LSRG is described in detail in Section 3.2.1.1. The signaling generated by a the NIF component in an ingress LSRG toward an ESRP on an i3 ESInet to support the establishment of an emergency call is described in Section 3.2.1.3.1. In addition, the NIF component in an ingress LSRG MUST be capable of processing signaling from the PIF component (see Section 3.1.4.3) and generating signaling toward an ESRP (see Section 3.2.1.3.3) related to an emergency transfer request initiated by a legacy PSAP that is served by an SR.

The NIF component of an egress LSRG MUST be capable of receiving and processing an incoming SIP INVITE message from an ESRP associated with an emergency origination, as described in Section 3.2.2. The NIF component of an egress LSRG MUST also be capable of receiving signaling from a conference bridge (see Section 3.2.2.5) and providing signaling to a PIF component in an egress LSRG to support transfer requests to legacy PSAPs that are served by SRs (see Section 3.1.4.4).

3.2.1 NIF Functionality – Ingress LSRG

3.2.1.1 Routing Determination for Emergency Originations

Upon receiving a SIP INVITE from a PIF component associated with an emergency origination, the NIF SHALL determine, based on incoming signaling, what information will be passed to the LIF component to serve as input to determination of the routing location for the call. (See Section 3.3.1 for further details related to processing at the LIF.) For emergency call originations routed via legacy SRs, the 10-digit location key(s)/identifier(s) passed by the NIF to the LIF SHALL consist of: calling number/ANI for wireline originations, ESRK or “MDN + ESRD” for wireless, or ESQK or “callback number + ESQK” for VoIP.

Upon obtaining a routing location associated with the emergency call, the LIF component SHALL pass the routing location to the NIF component (as described in Section 3.3.1).

Once the NIF component receives a routing location from the LIF component in geodetic or civic format, the NIF MUST be capable of generating a routing request to an external ECRF. The NIF SHALL use the Location to Service Translation (LoST) protocol, as described in RFC 5222 [17] to query the ECRF. The NIF component SHALL generate a LoST <findService> request message that includes the routing location received from the LIF and a service URN of urn:service:sos. If the NIF does not receive a routing location from the LIF component within a pre-specified period of time, the NIF component SHALL use a default location (based on the incoming trunk group information provided in the Contact header field of the INVITE message from the PIF component) to query the ECRF.

The NIF component of the LSRG SHALL set a query response timer when it initiates a routing query. The value of this timer SHALL be settable by the LSRG operator.

The LSRG SHALL be capable of receiving and processing a LoST <findServiceResponse> message from the ECRF, formatted as described in RFC 5222 [17]. Upon receiving a response from the ECRF, the NIF SHALL determine the outgoing route for the call using the URI of the target ESRP received in the LoST response. If the NIF component of the LSRG does not receive a response to a LoST query within a provisioned time period, or receives an error indication from the ECRF, it SHALL log the event and route the call based on a provisioned default ESRP URI.

Note that there are some scenarios where it may not be necessary for an ingress LSRG to perform a routing query. In some deployments, the service architecture may dictate that all emergency calls delivered to a specific LSRG will always be routed to the same ESRP. In this case, it is reasonable to configure the LSRG not to perform a routing query and instead route each call using provisioned routing information. It is also possible that the incoming trunk group on which the emergency call is received (as communicated in the Contact header of the SIP INVITE message sent by the PIF component to the NIF component) will provide enough information about the location of the caller to identify the appropriate ESRP to be used to route the call to/toward the correct PSAP. In this case, the LSRG will be provisioned with routing information that is based on the incoming trunk group, and the LSRG will use this routing information rather than performing a routing query to an ECRF to determine to which ESRP to route the emergency call.

The LSRG MUST support an interface for making routing queries. Based on operator preferences dictated by deployment architectures, as well as the relationship between the LSRG operator and the operators of the legacy SR and the ESInet, there may be cases where it is more practical to use provisioned routing information rather than a routing query. However, providers of LSRG systems are REQUIRED to build systems that support a LoST interface that can be used to query an ECRF for routing information.

In addition to determining the outgoing route, the NIF component of the ingress LSRG MAY generate one or more data blocks that contain additional data about the call. These Additional Data blocks SHALL contain the mandatory information identified in Section 3.1.15 of NENA-STA-010.3-2021 [43] as well as any other non-location information associated with the call that is provided to the NIF by the LIF, formatted according to RFC 7852 [14]. The NIF MAY include this Additional Data (or a subset of it) "by-value" in the body of the outgoing SIP message it sends to the ESRP, and/or it MAY generate a pointer/reference to that data structure. The pointer SHALL contain the URI of the Additional Data Repository (ADR) where the Additional Data is stored. The URI generated by the NIF SHOULD include the callback number. If the NIF generates a pointer/reference to an Additional Data structure, it SHALL include the reference URI in the Call-Info header of the INVITE message sent to the ESRP, with a purpose parameter beginning with "EmergencyCallData", a dot and the block name of the Additional Data structure. If the NIF passes Additional Data by reference, and the reference refers to the LSRG, the NIF component of the LSRG MUST maintain an ADR interface, utilizing the HyperText Transfer Protocol Secure (HTTPS) GET method described in RFC 7230 [25], to support dereference requests for Additional Data.

3.2.1.2 Handling of Transferred Emergency Calls Initiated by a Legacy PSAP that is Served by an SR

As described in Section 3.1.4.3, the PIF component SHALL generate SIP INVITE messages associated with emergency calls that are transferred by a legacy PSAP that is served by a legacy SR to an i3 PSAP, and pass them to the NIF component. The NIF component SHALL recognize that the SIP INVITE from the PIF component is associated with a transferred call based on the presence of the 10-digit number/address associated with the transfer-to PSAP (or other destination), formatted as a URI, in the Request-URI and To header, and a cpc parameter in the P-Asserted-Identity header that contains the value "emergency service call". The SIP INVITE message from the PIF component will also contain the pANI that was assigned by the NIF component and associated by the NIF with the original emergency call (using the procedures described in Section 3.2.2.1). Depending on the encoding of the SS7 IAM associated with the call transfer delivered by the SR to the PIF component, the pANI will either be received by the NIF component in the From header or the P-Asserted-Identity header of the INVITE associated with the transferred call. In processing the original emergency call, the NIF component will have retained the callback information, location information and Additional Data received in incoming signaling from the ESInet/NGCS and established an association between the pANI and that information (see Section 3.3.3). To support the transfer of the emergency call, the NIF component SHALL create an EIDO that contains the callback information, location information and Additional Data associated with the pANI. The NIF component SHALL then generate a SIP INVITE message and send it to an ESRP on the ESInet, as described in Section 3.2.1.3.3. Note that the NIF component will not interact with the LIF component prior to generating the SIP INVITE message associated with the transferred call.

3.2.1.3 NIF Sends SIP INVITE to ESRP (Ingress LSRG Function)

3.2.1.3.1 SIP INVITE Associated with an Emergency Origination

If the NIF component of the ingress LSRG receives an INVITE message from the PIF component associated with an emergency call origination from a legacy E9-1-1 Network, it SHALL behave as a B2BUA and generate an outgoing SIP INVITE message and send it to an ESRP. The SIP INVITE message generated by the NIF component SHALL contain the following information:

- A Request-URI that contains a service URN in the "sos" tree (i.e., urn:service:sos)
- A To header that contains the digits "911"
- A From header that contains the callback number (or Originating TN for legacy wireline emergency call originations) received by the NIF component in incoming signaling from the PIF component, or retrieved by the LIF component, as appropriate for the type of emergency call origination.
  - If the "Service Delivered by Provider to End User" element provided by the LIF component is equal to "POTS," the NIF component SHALL populate the From header based on the Calling Party Number received in the From and PAI headers of the incoming INVITE message from the PIF component.
  - If the "Service Delivered by Provider to End User" element provided by the LIF component is equal to "Wireless", then the NIF component SHALL populate the From header as follows:
    - If the From header and the PAI header of the incoming INVITE message from the PIF component are not the same (i.e., a GDP was received in the incoming signaling from the SR), the NIF component SHALL use the value provided in the PAI header of the INVITE message from the PIF component to populate the From header of the outgoing INVITE message.
    - If the From header and the PAI header of the incoming INVITE message from the PIF component are the same (i.e., no GDP was present in the incoming signaling from the SR), the NIF component SHALL use the callback number provided by the LIF component to populate the From header of the outgoing INVITE message. If the LIF component does not provide a callback number to the NIF component within a pre-specified period of time, the NIF component SHALL

populate the From header with the value received in the incoming INVITE message from the PIF component.

- If the call was originated by a non-initialized mobile caller (i.e., the callback number is of the form 911+ "last 7 digits of the Electronic Serial Number or IMEI expressed as a decimal") the NIF component SHALL populate the From header with a value of "Anonymous."

- A PAI header that contains the callback number retrieved by the LIF component or received in incoming signaling from the PIF component, as appropriate for the type of emergency call origination. Note that the PAI header sent by the NIF component to the ESRP SHALL NOT contain cpc or oli parameters.
  - If the "Service Delivered by Provider to End User" element provided by the LIF component is equal to "POTS," the NIF component SHALL populate the PAI with the SS7 Calling Party Number information received in the PAI header of the incoming INVITE message from the PIF component.
  - If the "Service Delivered by Provider to End User" element provided by the LIF component is equal to "Wireless", then the NIF component SHALL populate the PAI header as follows:
    - If the From header and the PAI header of the incoming INVITE message from the PIF component are not the same (i.e., a GDP was received in the incoming signaling from the SR), the NIF component SHALL use the SS7 Calling Party Number value provided in the PAI header of the INVITE message from the PIF component to populate the PAI header of the outgoing INVITE message.
    - If the From header and the PAI header of the incoming INVITE message from the PIF component are the same (i.e., no GDP was present in the incoming signaling from the SR), the NIF component SHALL use the callback number provided by the LIF component to populate the PAI header of the outgoing INVITE message. If the LIF component does not provide a callback number to the NIF component within a pre-specified period of time, the NIF component SHALL omit the PAI header from the outgoing INVITE message.
  - If a non-initialized mobile caller originated the call, the NIF component SHALL omit the PAI header from the message.
- A P-Charge-Info header, if one was received in the INVITE message from the PIF component, will contain the information that was delivered to the LSRG in an SS7 Charge Number parameter or MF ANI.
- A Via header that is populated with an identifier for the LSRG
- A Route header that contains the ESRP URI obtained from the ECRF

- A Contact header that contains the SIP URI that is associated with the LSRG, along with a "urn:emergency:media-feature.tty-interworking" media feature tag
- A Supported header that contains the "geolocation" option tag.
- Geolocation header that either:
    - Points to the message body (using a "Content Identification (cid)" URI, as defined in RFC 2392) where a Presence Information Data Format – Location Object (PIDF-LO) containing the location value retrieved by the LIF component is coded (see Section 4.3 and RFC 6442)[9], or
    - Contains a location-by-reference URI[10]
- A Geolocation-Routing header set to "yes"
- An SDP offer, as received from the PIF component
- If, during the processing of the emergency call, the NIF component of the LSRG creates an "Additional Data" data structure (e.g., containing Service Type information formatted according to RFC 7852 [14]) and stores it, the NIF component of the LSRG SHALL include one or more[11] Call-Info header fields with a purpose parameter beginning with "EmergencyCallData", a dot and the block name of the Additional Data structure and a URI associated with the ADR that contains the "Additional Data" data structure which, when dereferenced, would yield additional information about the call.
- If, during the processing of the emergency call, the NIF component of the LSRG creates an "Additional Data" data structure and sends it forward "by value" in the outgoing INVITE message, the NIF component of the ingress LSRG:
    - SHALL populate each data structure as a body part of the INVITE message with a MIME type of "Application/EmergencyCallData", a dot and the block name of Additional Data.
    - For each Additional Data structure SHALL include a Call-Info header field with a purpose parameter set to "EmergencyCallData.", a dot and the block name of the Additional Data, and a value set to the cid: URI that points to the body part containing the Additional Data.
    - Each Additional Data structure is contained in one body part and referenced by one Call-Info header field that identifies the block type and the CID.

[9] This method will be used for wireline emergency originations.

[10] This method will be used for wireless Phase 1 and Phase 2 emergency originations to allow the queries for routing location as well as for initial and updated caller location.

[11] The NIF MUST add at least ProviderInfo and ServiceInfo and MAY add SubscriberInfo blocks as described in Section 4.11 of NENA-STA-010.3. These MAY be referenced in one Call-Info header field with multiple URIs or multiple Call-Info header fields with one or more URIs.

- A P-Preferred-Identity header populated with 911 + "last 7 digits of the ESN or IMEI expressed as a decimal" if the call was originated by a non-initialized mobile caller.
- Other headers may be included per normal SIP behavior, as defined in RFC 3261 [13].

After sending the SIP INVITE to the ESInet, the NIF SHALL return a SIP Trying (100) message to the PIF.

The NIF component of an ingress LSRG SHALL be capable of receiving and processing a 180 Ringing message or a 183 Session Progress message that contains a "urn:emergency:media-feature.tty-interworking" or "text" media feature tag from the ESInet/NGCS in response to the SIP INVITE associated with an emergency origination. If the NIF component receives a 180 Ringing message, it SHALL send a 180 Ringing message to the PIF component. If the NIF component receives a 183 Session Progress message, it SHALL send a 183 Session Progress message to the PIF component.

The NIF component SHALL also be capable of receiving and processing a 200 OK message from the ESInet/NGCS. If the NIF component receives a 200 OK message from the ESInet/NGCS, it SHALL send a 200 OK message to the PIF component. The NIF component SHALL be capable of receiving and processing an ACK message from the PIF component in response to the 200 OK message. The NIF component SHALL subsequently send an ACK message to the ESInet/NGCS.

If callback information is not available at the time that the initial INVITE message is sent by the NIF component to the ESRP, but is subsequently provided by the LIF component, the NIF component of the ingress LSRG SHALL generate a re-INVITE message to communicate this information to the PSAP. The re-INVITE message will reference the existing dialog so that the i3 PSAP (or Legacy PSAP Gateway, or egress LSRG, in the case of a legacy PSAP) knows that it is to modify an existing session instead of establishing a new session. The re-INVITE message SHALL include the following information:

- A Request-URI that contains the information provided in the Contact header of the 200 OK message that was returned in response to the original INVITE message. (e.g., sip:psap1@example.com)
- A To header that contains the same information as the original INVITE message (i.e., the digits "911") expressed as a URI (i.e., sip:911@vsp.com).
- A From header that contains the same information as in the original INVITE message (i.e., the From header will be populated with the value received in the incoming INVITE message from the PIF component, which is the ESRK/ESQK, e.g., sip:ESRK@carrier.com;user=phone).

- A P-Asserted-Identity (PAI) header that contains the callback number retrieved by the LIF component (e.g., sip:<TN>@vsp.com;user=phone).
- A Via header that is populated with the element identifier for the LSRG (e.g., lsrg.carrier.com)
- A Route header that contains the same information as in the original INVITE (i.e., the ESRP URI obtained from the ECRF)
- A Contact header that contains the same information as in the original INVITE message (i.e., a SIP URI associated with the ingress LSRG and a media feature tag of "urn:emergency:media-feature.tty-interworking").

The i3 PSAP/Legacy PSAP Gateway/egress LSRG will return a 200 OK to indicate that it accepts the change, and the NIF component of the ingress LSRG SHALL respond to the 200 OK by returning an ACK message.

The NIF component SHALL be capable of receiving and processing a BYE message from the ESInet/NGCS. If the NIF component receives a BYE message from the ESInet/NGCS, it SHALL pass it to the PIF component. The NIF component SHALL be capable of receiving and processing a 200 OK message from the PIF component in response to the BYE message, and SHALL subsequently send a 200 OK message to the ESInet/NGCS.

If the NIF component receives other SIP messages from the ESInet/NGCS, it SHALL validate them and if necessary, apply the appropriate error handling per RFC 3261 [13]. If the messages pass the validity checks, the NIF component SHALL pass them to the PIF component.

The NIF component SHALL be capable of receiving and processing a BYE message from the PIF component. If the NIF component receives a BYE message from the PIF component, it SHALL send a BYE message to the ESInet/NGCS. Upon receiving a 200 OK message from the ESInet/NGCS in response to the BYE message, the NIF component SHALL return a 200 OK message to the PIF component.

3.2.1.3.2 SIP Re-INVITE Sent by Ingress LSRG NIF Component to ESRP Associated with TTY Origination

If the NIF component of an ingress LSRG receives a re-INVITE message from the PIF component (because the PIF component has detected Baudot tones after the initial audio session was established and an RFC 4103 [10] text media session has not already been established based on a re-INVITE from an i3 PSAP, Legacy PSAP Gateway, or egress LSRG), the NIF component SHALL send a re-INVITE message toward the PSAP requesting the establishment of a Real Time Text media session. (See Section 3.2.1.4 for further discussion of media handling by the NIF component associated with TTY originations.) The re-INVITE message SHALL include the following information:

- A Request-URI that contains the information provided in the Contact header of the 200 OK message that was returned in response to the original INVITE message
- A To header that contains the same information as the original INVITE message (i.e., the digits "911")
- A From header that contains the same information as in the original INVITE message
- A P-Asserted-Identity (PAI) header that contains the callback number included in the previous INVITE message
- A Via header that is populated with the element identifier for the ingress LSRG
- A Route header that contains the same information as in the original INVITE (i.e., the ESRP URI obtained from the ECRF)
- A Contact header that contains the same information as in the original INVITE message (i.e., a SIP URI associated with the ingress LSRG along with a "urn:emergency:media-feature.tty-interworking" media feature tag)
- An SDP offer that includes Real Time Text, as described in RFC 4103 [10] and G.711 audio.

The i3 PSAP/Legacy PSAP Gateway/egress LSRG SHALL return a 200 OK to indicate that it accepts the change, and the ingress LSRG NIF component SHALL respond to the 200 OK by returning an ACK message. The NIF component SHALL also pass the 200 OK to the PIF component. The PIF component SHALL respond by returning an ACK message.

3.2.1.3.3 SIP INVITE Associated with a Transferred Emergency Call Initiated by a Legacy PSAP that is Served by an SR

SIP signaling will also be exchanged between an ESRP and an LSRG associated with transferred emergency calls. The NIF component of an ingress LSRG MUST be capable of generating a SIP INVITE message associated with a call that is being transferred from a PSAP that is served by a legacy SR to a PSAP that is interconnected via an i3 ESInet. The SIP INVITE message generated by the NIF component of the LSRG and sent to an ESRP to support this transfer scenario SHALL contain the following information:

- A Route Header that contains the10-digit number/address associated with the target PSAP (expressed as a URI)
- A Request URI containing a service urn, such as urn:emergency:service:sos.police

- A To header that contains the 10-digit number/address associated with the transfer-to PSAP, formatted as a URI
- A From header that contains the callback number associated with the pANI received in the From header or P-Asserted-Identity header of the SIP INVITE from the PIF component.
- A P-Asserted-Identity (PAI) header that contains the callback number associated with the pANI received in the From header or P-Asserted-Identity header of the SIP INVITE from the PIF component. Note that the PAI header sent by the NIF component to the ESRP SHALL NOT contain cpc or oli parameters.
  - If a non-initialized mobile caller initiated the original emergency call, the PAI header will be omitted.
- A Via header that is populated with an identifier for the LSRG
- A P-Charge-Info header, if present in the received INVITE from the PIF component.
- A Contact header that contains a URI associated with the LSRG and a "urn:emergency:media-feature.tty-interworking" media feature tag
- A Call-Info header that contains a URI which can be used to access an Emergency Incident Data Object (EIDO).[12]
- An SDP offer, as received from the PIF component, that includes the G.711 codec, as well as a media format associated with RTT (if a text media session has been established for the emergency call).
- A History-Info header, as specified in RFC 4244, with a Reason parameter that includes an indication of why and how the call arrived at the LSRG (i.e., because the call has undergone diversion).
- Other headers may be included per normal SIP behavior, as defined in RFC 3261 [13].

3.2.1.4 Handling of Media Associated with TTY Calls

As described in Section 3.1.2.1, if an ingress LSRG receives an incoming TTY call, the PIF component will be responsible for recognizing the Baudot tones in incoming media and replacing them with RFC 4103 [10] Real Time Text. Likewise, the PIF component will be responsible for generating Baudot tones in outgoing media if Real Time Text is received in

[12] The EIDO may be conveyed by-reference or by-value. If it is conveyed by-reference, the LSRG provides the dereference service. If provided by-value, implementations should consider the size of the outgoing INVITE.

RTP packets. However, while RFC 4103 [10] describes a mechanism for carrying real-time text conversation session contents in RTP packets, it provides little guidance for handling the "turn-taking" that is inherent in interworking with TTY devices. TTY can transmit in one direction at a time (half duplex) and, as a result, TTY communications include conventions for strict "turn-taking" procedures. In the legacy environment, these procedures are adhered to by the users at each end. However, when a network element (e.g., an LSRG) interworks between IP and TTY, it is important that that element emulate these procedures. There are currently no industry standards that describe this critical aspect of TTY interworking, however in the context of the LSRG, the NIF component will be responsible for facilitating the "turn-taking" expected by TTY users involved in emergency calls.

While a TTY caller is sending characters, the NIF component at the ingress LSRG MUST buffer any RFC 4103 [10] characters it receives from the ESInet/NGCS. When a "_GA"[13] (where the underscore indicates a space character) is received from the caller via the PIF, the NIF component will set an inter-character timer of 1500 ms. If a space or line delimiter is received, or the 1500 ms timer expires without any other character being received, the NIF will recognize that a change in turn is in effect. The NIF SHALL perform one of the following procedures, depending on the capabilities of the far end, as indicated by the value of the media feature tag returned by the far end in response to the SIP INVITE generated by the NIF. If, instead, a character other than space or line delimiter is received from the TTY user before the 1500 ms timer expires, then the NIF component will recognize that the " GA" was the beginning of a regular word, and reception of text from the TTY user will continue with no change of turn.

If a change of turn is in effect, and the media feature tag returned in a response to the initial SIP INVITE message generated by the NIF component has the value "text", the NIF SHALL substitute a line delimiter (e.g., CRLF) for the "GA" and forward the line delimiter to the ESInet. The NIF SHALL then send any buffered characters received from the ESInet to the caller via the PIF, and SHALL continue forwarding characters received from the ESInet in real time to the TTY caller using the mechanism described below.

If a change of turn is in effect, and the media feature tag received by the NIF component in a response to the initial SIP INVITE message has the value "urn:emergency:media-feature.tty-interworking", the NIF component SHALL pass the string of text characters

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[13] It is a convention when using TTY to type the characters "GA" for "Go Ahead" at the end of the typed message when one user wants to give turn to the other user. The following should also be interpreted as end of message values to address scenarios where there is a lost shift character: "+-" and "<BELL>)" (where the bell-character is U+0007 when converted to RFC 4103 [10] text). See Emergency Access Advisory Committee (EAAC) Report on procedures for calls between TTY users and NG9-1-1 PSAPs [23] for further details.

(including the "GA") toward the PSAP, unchanged. As above, the NIF SHALL then send any buffered characters received from the ESInet to the caller via the PIF, and SHALL continue forwarding characters received from the ESInet in real time to the TTY caller using the mechanism described below.

The NIF component MUST be capable of sending text characters received from the ESInet toward a TTY caller. When the ESInet is sending text characters toward a TTY caller, the NIF will use the presence of a pre-defined pause between characters, or the presence of a " GA" or a line delimiter, to simulate a request by the PSAP to change the turn. Upon detecting a request to change the turn, the NIF component will add a "_GA" to the end of the text characters that are to be sent toward the caller , if "_GA" is not already present in the received text characters, as follows.

To support the interworking of RFC 4103 [10] real-time text to Baudot tones performed by the PIF component of the ingress LSRG, the NIF component SHALL initiate a provisionable inter-character timer, with a default value of 7 seconds, upon receipt of the first RFC 4103 [10] text character from the ESInet. This timer SHALL be restarted with a value of 7 seconds every time a character is transmitted towards the TTY caller. If the characters "_GA" are detected, the inter-character timer shall be reduced to 1500 ms and if the NIF component receives no further text before the 1500 ms timer expires, the NIF component SHALL pass the text characters to the PIF component, unchanged. At this point, the turn will be changed and the NIF component will begin buffering any subsequent text from the ESInet. If additional text (other than a space or line delimiter) is received before the 1500 ms expires, the NIF component SHALL set the inter-character timer at 7 seconds and again continue forwarding characters toward the TTY caller and wait for a "_GA" or line delimiter.

If a line delimiter is detected before the 7-second timer expires, the NIF component SHALL replace the line delimiter with a space and SHALL reset the inter-character timer to 1500 ms. If the inter-character timer expires without a "_GA" being detected, the NIF component SHALL append the characters "_GA" to the incoming RFC 4103 [10] text and pass the text characters with the "_GA" appended to the PIF component for conversion to Baudot tones. At this point, a change of turn is performed, and the NIF component starts buffering characters received from the ESInet. If the NIF component receives a "_GA" before the 1500 ms timer expires, the NIF component SHALL follow the procedure described above for receipt of a "_GA". Once the inter-character timer has been initiated to 1500 ms, the receipt of space characters or line delimiters SHALL NOT cause the timer to be reset, rather the same procedure shall be followed as when the 1500 ms timer has expired.

The intention of the above procedure is to change turn and send "_GA" to the TTY caller when the PSAP sends a line delimiter or "_GA", possibly followed by spaces or line delimiters, but not immediately followed by text. A change of turn will also be made and

"_GA" sent to the TTY caller when the PSAP is idle for an extended period of time, assuming that the PSAP makes no specific action to change turn. (A PSAP idle time of 7 seconds is specified in the Emergency Access Advisory Committee (EAAC) Report on procedures for the TTY as a text terminal in legacy 9-1-1 PSAPs without IP connection [23].) The NIF component will replace line delimiters used for text formatting (e.g., by i3 PSAPs) with a space because most TTYs have a limited display of only one or two lines. Such line delimiters SHALL NOT cause the NIF component to change turn. In addition, words beginning with "GA" should also not cause a change of turn. It is assumed that in such cases the next character in the word will be sent within the 1500 ms.

3.2.2 NIF Functionality – Egress LSRG

3.2.2.1 NIF Handling of SIP INVITE from ESRP Associated with an Emergency Origination

The NIF component of an egress LSRG MUST also be prepared to receive and process INVITE messages from ESRPs associated with emergency call originations that are routed via the ESInet to the LSRG, and are destined for PSAPs served by SRs. The NIF component SHALL be capable of receiving and processing the following information in the received SIP INVITE message:

- A Route Header that contains the10-digit number/address associated with the target PSAP (expressed as a URI resolving at the gateway, e.g., sip:telno@lsrg;user=phone)
- A To header that contains the digits "911" (e.g., expressed as a URI, e.g., sip:911@vsp.com)
- A From header that contains the Address of Record of the caller, which consists of the callback number/address associated with the user/device that originated the emergency call (e.g., sip:TN@vsp.com;user=phone), or "Anonymous", if available. Under certain circumstances (i.e., where callback information is not available at the time that the initial INVITE message is sent by the NIF component, as described in Section 3.2.1), the From header may contain an ESRK/ESQK).
- A P-Asserted-Identity header that contains callback information expressed as a URI (e.g., sip:<TN>@vsp.com;user=phone). If the call originated from a non-initialized mobile device, the P-Asserted-Identity header may not be present[14]; if not signaled in the P-Asserted-Identity header, a P-Preferred-Identity containing "911 + last 7

[14] Based on 3GPP and ATIS standards, emergency calls from IMS originating networks will signal non-dialable callback numbers in the P-Asserted-Identity header.

digits of the ESN or IMEI expressed as a decimal" will be present. If callback information was not available when the initial SIP INVITE was received by the ESRP, the P-Asserted-Identity will be absent from the received INVITE message.

- A Via header that is populated with an identifier for the ESRP (added to other Via headers present in the INVITE received by the ESRP)
- A Record Route header containing an ESRP URI, if present in the SIP INVITE received from the ESRP.
- A Request URI header that contains an emergency service URN (i.e., urn:service:sos)
- A Contact header whose content consists of one of the following, depending on the transfer model implemented by the ESInet, and includes either a "text" media feature tag or a "urn:emergency:media-feature.tty-interworking" media feature tag[15].
  - a SIP URI or tel URI identifying the user to facilitate an immediate call back to the device that placed the emergency call, or a SIP URI associated with a Legacy Network Gateway or ingress LSRG, if the RFC 4579-based transfer model described in Section 4.7.1.1 of NENA-STA-010.3 [43] is implemented
  - a SIP URI associated with a B2BUA, if the transfer model described in Section 4.7.1.2 of NENA-STA-010.3 is implemented
  - a SIP URI that is associated with the Conference Aware UA, if the transfer model described in Section 4.7.1.3 of NENA-STA-010.3 is implemented
- A Supported header that contains the information received by the ESRP (including a geolocation option tag).
- A Geolocation header that contains a Content Identifier or location reference URI
- A Geolocation-Routing header set to "yes"
- An SDP offer, as received by the ESRP.

[15] If the originating network from which the emergency call is received is an IP network, the media feature tag received by the NIF and passed to the PIF will contain a "text" value. If the originating network from which the emergency call is received is a legacy network, the media feature tag received by the NIF and passed to the PIF component of the egress LSRG will have the value "urn:emergency:media-feature.tty-interworking".

- A Call-Info header that contains a URI which, when de-referenced, can be used to access additional information about the call, or a cid: URI that points to additional information populated in the message body.
- A History-Info header, as specified in RFC 7044 [53], with a Reason parameter (as received in the incoming INVITE from the ESRP)
- Other headers may be included per normal SIP behavior, as defined in RFC 3261 [13].

Upon receiving a SIP INVITE message from an ESRP, the NIF component SHALL analyze the signaled information and apply NG9-1-1-specific processing to identify the outgoing trunk group over which the call will be delivered to the interconnected legacy SR, and to ensure that the information delivered to the legacy SR is in an acceptable format. The NIF component of the LSRG SHALL select the outgoing route to the SR based on the destination PSAP number/address provided in the Route URI of the INVITE message from the ESRP. SS7 interfaces to legacy SRs assume that callback information and/or location keys (i.e., pANIs) signaled to the legacy SR will be in the form of a 10-digit NANP number. It is possible that some emergency originations (e.g., from VoIP callers) will contain callback information that is not in the form of (or easily converted to) a 10-digit NANP number. If callback information is to be delivered to the SR and it is not in the form of (or easily converted to) a 10-digit NANP number, the NIF component of the LSRG SHALL perform a mapping from the non-NANP callback information to a pseudo callback number that falls within the range of NPA-511-8950 through NPA-511-8999 (if the NPA is one of 281, 405, 806, 870, and 903) or in the range NPA-211-9950 through NPA-211-9999 (for any other NPA in the United States), as appropriate for the destination PSAP.

The NIF component of the LSRG MUST also identify the appropriate ESN value for the call. The ESN is important because the NIF will select a value for the pANI associated with the location information from the provisioned pool of values that is associated with the ESN. The NIF SHALL use the following procedure to determine the ESN for the emergency call:

- If an ESN is provided in the SIP INVITE received from the ESRP (i.e., by value in the Additional Data associated with a legacy origination processed by a Legacy Network Gateway), the NIF SHALL use the received value as the ESN for the call.
- If the NIF cannot determine the ESN based on the incoming SIP INVITE message from the ESRP, it SHALL pass the received location information and Additional Data (by-reference) to the LIF component and use the ESN value obtained by the LIF. (See Section 3.3.2 for further details.)

If the NIF component fails to determine an ESN value for the call based on incoming signaling and does not receive an ESN value for the call from the LIF component, the NIF

SHALL determine the value of the pANI based on configured data associated with the PSAP URI.

The NIF SHALL retain the location information provided in the Geolocation header of the incoming INVITE message and create an association between the location information and an ESN-appropriate 10-digit pANI.

- If the location information received in the SIP INVITE message from the ESRP contains a location-by-value, the NIF SHALL associate an ESN-appropriate pANI that falls within the range of NPA-511-8950 through NPA-511-8999 (if the NPA is one of 281, 405, 806, 870, and 903) or in the range NPA-211-9950 through NPA-211-9999 (for any other NPA), as appropriate for the destination PSAP. (Note that the same ESN-appropriate pANI can be used to represent both the callback and location information.)
- If the location information received in the SIP INVITE message from the ESRP contains a location-by-reference, the NIF SHALL first check to see whether the location reference URI contains a value that is easily converted to a 10-digit NANP number (i.e., is of the form "+1NPANXXXXXX").[16] If the value of the location reference URI is of the form "+1NPANXXXXXX", the NIF component SHALL use the NPA-NXX-XXXX portion of the location reference URI as the pANI that is the key to the location associated with the emergency call. If the content of the location reference URI is not of the form "+1NPANXXXXXX", the NIF SHALL use the mechanism described above to associate an ESN-appropriate pANI with the location information.

The NIF SHALL set a guard timer once the pANI value has been associated with a call. The specific value of this timer SHALL be settable by operations personnel.

The NIF component SHALL formulate a SIP INVITE message and send it to the PIF component, as described in Section 3.1.4.2. The NIF SHALL also pass the pANI and the associated callback and location information to the LIF component to support location delivery to the legacy PSAP. (See Section 3.3.3 for further discussion.)

Subsequent SIP messages (e.g., 100 TRYING, 183 SESSION PROGRESS, 180 RINGING, 200 OK, BYE, ACK) exchanged between the egress LSRG and the ESRP associated with emergency call originations routed via an ESInet to the LSRG SHALL be coded as described in RFC 3261 [13], with the following clarification. The NIF component SHALL include a media feature tag with the value "urn:emergency:media-feature.tty-interworking" in the

[16] For example, the location reference URI may contain an ESRD that is representative of the cell site/sector from which a legacy wireless emergency call originated.

183 SESSION PROGRESS or 180 RINGING message returned to the ESRP in response to a SIP INVITE associated with an emergency origination.

If the NIF component has generated a pANI value associated with an emergency call, then upon receiving a BYE message indicating termination of that emergency call, the NIF component SHALL return the pANI value associated with the call to the appropriate pool of available pANIs. If the NIF component does not receive a BYE message for the call before the guard timer associated with that pANI value expires, the NIF component SHALL release that pANI upon the expiration of the guard timer. If the NIF component receives a BYE message after the guard timer has expired and the pANI has been released, the NIF SHALL log the event and make a maintenance count.

3.2.2.1.1 Handling of Advanced Automatic Crash Notification Calls

When a Next Generation Advanced Automatic Crash Notification (NG-AACN) call is presented to the ESInet/NGCS, the SIP INVITE message associated with that call will contain a telematics Vehicle Emergency Data Set (VEDS) and a metadata/control object indicating the capabilities of the vehicle/Telematics Service Provider (TSP). If the NIF component of an egress Legacy Selective Router Gateway receives such a SIP INVITE message, it SHALL NOT attach a metadata/control object to its final response to the SIP INVITE message. This will convey to the vehicle or TSP that the call is not end-to-end NG-AACN, and will cause the vehicle/TSP to fall back to legacy mechanisms for conveying crash and location data (e.g., using text-to-speech, pre-recorded audio, or verbal interaction with the TSP assistant).

3.2.2.2 SIP Re-INVITE Sent to the ESInet to Support "Silent" Emergency Calls

As described in Section 3.1.4.2.1, if an emergency call is presented to the PSAP as a "silent" call, then based on the Standard Operating Procedures defined in NENA-STA-037.2-2018 (originally NENA 56-004), the PSAP will generate Baudot tones toward the caller. This will require the establishment of a Real Time Text media session. If an RFC 4103 [10] text media session has not already been established, the PIF component of the egress LSRG will generate a SIP re-INVITE message (as described in Section 3.1.4.2.1) and send it to the NIF component. Upon receiving a SIP re-INVITE from the PIF component, the NIF component of the egress LSRG SHALL generate a SIP re-INVITE message and send it toward the caller, Legacy Network Gateway, or ingress LSRG via the ESInet/NGCS. The SIP re-INVITE message SHALL include the following information:

- A Request-URI that contains a URI from the Contact header delivered to the LSRG in the initial INVITE message. The URI may be associated with the Legacy Network Gateway, the ingress LSRG, the caller, a B2BUA, or a Conference Aware UA, as appropriate for the origination type and the transfer model implemented.

- A To header that contains the information delivered to the egress LSRG in the From header of the original INVITE message.
- A From header that contains the digits "911" expressed as a URI (received in the To header of the original INVITE message).
- A Contact header that contains a SIP URI associated with the egress LSRG along with a "urn:emergency:media-feature.tty-interworking" media feature tag.
- A Via header that is populated with a URI associated with the egress LSRG.
- An SDP offer that includes Real Time Text, as described in RFC 4103 [10].

Upon receiving a 200 OK message indicating that the SDP offer associated with Real Time Text has been accepted, the NIF component SHALL pass the 200 OK message to the PIF component. The PIF component SHALL respond by sending an ACK to the NIF component, and the NIF component SHALL send an ACK toward the caller/Legacy Network Gateway/ingress LSRG.

3.2.2.3 SIP Re-INVITE Received from the ESInet Requesting the Addition of Text Media to an Emergency Call

The NIF component of an egress LSRG MUST be capable of receiving and processing a re-INVITE message from the i3 ESInet/NGCS that requests the addition of a text media session (either RFC 4103 [10] Real Time Text or MSRP) to an established emergency call (i.e., with audio media). Specifically, the NIF component SHALL be capable of receiving a processing a re-INVITE message from the i3 ESInet that includes the following information:

- A Request-URI that contains the information provided in the Contact header of the 200 OK message that was returned in response to the original INVITE message
- A To header that contains the same information as the original INVITE message (i.e., the digits "911")
- A From header that contains the same information as in the original INVITE message
- A P-Asserted-Identity (PAI header that contains the callback information included in the previous INVITE message
- A Via header that contains the same information as in the original INVITE
- A Route header that contains the same information as in the original INVITE (i.e., the ESRP URI obtained from the ECRF)
- A Contact header that contains the same information as in the original INVITE message (i.e., a SIP URI along with either a "text" media feature tag or a "urn:emergency:media-feature.tty-interworking" media feature tag)
- An SDP offer that includes Real Time Text, as described in RFC 4103 [10], or MSRP, as described in RFC 4975 [44].

The NIF component SHALL pass the re-INVITE to the PIF component, populating the various fields as described for the original INVITE message sent to the PIF component (see Section 3.2.2.1) and including the SDP text media offer received in the incoming re-INVITE message from the i3 ESInet/NGCS. Upon receiving a 200 OK from the PIF component, the NIF component SHALL pass the 200 OK message toward the caller (via the i3 ESInet) and SHALL return an ACK message to the PIF component.

3.2.2.4 Handling of Media: RTT and MSRP

The NIF component of an egress LSRG MUST be capable of conveying incoming Real Time Text (RFC 4103 [10]) media between the i3 ESInet/NGCS and the PIF component at the egress LSRG. (The PIF component will be responsible for interworking the Real Time Text to TTY Baudot tones, as described in Section 3.1.2.2.) The NIF component of an egress LSRG MUST also be capable of interworking between MSRP messages associated with SMS/MMS/IM originations and RFC 4103 [10] Real Time Text media. MSRP messages are sent in "session mode", where the entire message is sent at one time. The NIF component SHALL be responsible for caching incoming MSRP messages and converting them to RFC 4103 [10] real-time text for delivery to the PIF component. Like the NIF component of an ingress LSRG, the NIF component of the egress LSRG SHALL also be responsible for facilitating the "turn-taking" expected by the TTY users involved a conversation between an emergency caller and a legacy PSAP.

Unless specific action is taken by the LSRG, session establishment associated with SMS/IMS/IM and RTT Text to 9-1-1 messages will appear to the legacy PSAP as "silent calls". The Standard Operating Procedures associated with the processing of silent calls will result in a delay in processing the 9-1-1 call as compared to a voice 9-1-1 call. To reduce delays associated with processing silent calls, some TTY device manufacturers support a feature that causes them to send a few space characters (subsequent to call establishment) as an indication that the call is from a TTY device. Based on the Standard Operating Procedures defined in NENA-STA-037.2-2018 (originally NENA 56-004) [26], upon hearing beeping tones, the PSAP should immediately initiate a TTY call response. To improve the response time associated with SMS/MMS/IM and RTT originations, this standard recommends that the NIF component support functionality that emulates the behavior of TTY devices that generate space characters to more quickly engage TTY equipment at the legacy PSAP.

When the NIF component receives a 200 OK message from the PIF component in response to a request from the ESInet to establish a RFC 4103 [10] text media session associated with an SMS/MMS/IM or RTT origination, it SHALL send a sequence of four (4) space characters in RFC 4103 [10] text with 350 milliseconds of silence between each space character to the PIF component, with five (5) seconds between each sequence, until it receives an RFC 4103 [10] text response from the PIF component.

If the NIF component does not receive a response from the PIF component (containing the interworked Baudot tones from the PSAP) within ten (10) seconds, the NIF component MUST send a preprogrammed message back to the caller that says something like "connecting to 9-1-1, please stand by". This may be repeated twice. If after 30 seconds, no Baudot tones are received from the PSAP, the NIF component MUST send a preprogrammed message back to the caller stating, for example, that text service is not available at this time and suggesting that the user make a voice call to 9-1-1 for assistance.

3.2.2.4.1 Text Exchanges Between Legacy PSAP and RTT or TTY Caller

Based on NENA-STA-037.2-2018 (originally NENA 56-004), the TTY equipment at the PSAP will respond to receipt of the space character(s) by sending a preprogrammed message or an approved greeting such as "911 GA" typed by the PSAP. If the call originated as an RTT call (i.e., the media feature tag conveyed in incoming signaling associated with the emergency call has a value of "text" and no MSRP session is established with the NIF component), then upon receiving the "911 GA" in RFC 4103 [10] text characters from the PIF component, the NIF component SHALL replace the "GA" with a line delimiter (e.g., CRLF)[17] and pass the "911" and line delimiter in RFC 4103 [10] characters back toward the caller. If the call originated as a TTY call (i.e., the media feature tag conveyed in incoming signaling associated with the emergency call has a value of "urn:emergency:media-feature.tty-interworking"), the NIF component SHALL pass the "911 GA" received in RFC 4103 [10] text characters from the PIF component, unchanged, back toward the caller. At this point, the text media session is established with a TTY or RTT calling user, and it is the caller's turn.

The NIF component SHALL then enter idle mode for a period of four (4) seconds as it waits for the initial text message from the caller (via the ESInet/NGCS). If there is already text buffered from the caller, the NIF component SHALL send the RFC 4103 [10] characters to the PIF component. If the NIF component receives RFC 4103 [10] characters from the caller before the expiration of the idle timer, the NIF component SHALL convey those characters to the PIF component, initiating an inter-character timer of 4 seconds. This timer SHALL be restarted with the value 4 seconds every time a character is transmitted towards the PSAP. If the time between characters exceeds 4 seconds, the NIF component SHALL send the characters "_GA" (where the underscore indicates a space character) to the PSAP, as defined in the EAAC Report [22]. The NIF component SHALL then enter idle mode as it waits for subsequent text from the PSAP (via the PIF component) or the caller

[17] Insertion of a line delimiter will allow text to be presented to the SMS/MMS/IM or RTT user in a form that is more readable and expected.

(via the ESInet). During this time the NIF component SHALL buffer any text received from the caller. If the NIF component detects a "_GA" from the PSAP before the expiration of the 4-second inter-character timer, the NIF component SHALL reset the inter-character timer to 1500 ms. If the NIF component receives a space, a line delimiter, or no further text before the 1500 ms timer expires, the NIF component SHALL send any buffered text characters from the caller (unchanged) to the PIF component, and SHALL continue conveying text in real time from the caller. The NIF component SHALL then enter idle mode. If additional text (other than a space or line delimiter) is received from the PSAP before the 1500 ms expires, the "GA" was part of the text conversation and the NIF component SHALL reset the 4 second timer and continue waiting for a "_GA" or line delimiter.

If the NIF component detects a line delimiter from the caller before the expiration of the 4 second inter-character timer, the NIF component SHALL replace the line delimiter with a space and SHALL reset the inter-character timer to 1500 ms. If the 1500 ms inter-character timer expires without any characters other than "_GA", or space or a line delimiter being detected, the NIF component SHALL append the characters "_GA" to the incoming RFC 4103 [10] text and send the text characters with the "_GA" appended to the PIF component for conversion to Baudot tones. The NIF component SHALL then enter idle mode with the PSAP having the turn and any incoming text from the caller being buffered. If other characters are received from the caller within the 1500 ms timer, the NIF SHALL convey the characters to the PIF component and SHALL reset the timer to 4 seconds.

If the NIF component receives subsequent text characters from the PIF component before the expiration of the idle timer and prior to any additional text messages being received from the ESInet, it SHALL examine the text for the presence of the characters "_GA". Note that it is common for a PSAP using TTY to end a question with "Q GA". Upon detecting a " GA", the NIF SHALL set the inter-character timer to 1500 ms. If a space, line delimiter or no other characters are received within the 1500 ms time period, and the caller is a TTY caller, the characters "_GA" or "Q_GA" will be passed unchanged toward the TTY caller. The turn is then changed to be the caller's turn. If the NIF component receives a "_GA" followed by nothing other than a space or line delimiter before the 1500 ms timer expires, and the caller is an RTT caller, the NIF SHALL substitute a line delimiter for the "_GA" in the RFC 4103 [10] text sent toward the RTT caller. In generating RFC 4103 [10] text corresponding to the characters "Q GA" toward an RTT caller, the NIF component SHALL replace the "Q" with a "?" and SHALL replace the "GA" with a line delimiter. If other characters are received before the expiration of the 1500 ms timer, the NIF should view the "_GA" or "Q GA" as part of the contents of the conversation and SHALL pass the characters unchanged toward the caller. The NIF SHALL then continue to convey characters from the PSAP to the caller.

If the NIF component detects that the call taker is sending text (i.e., it has not yet received the "_GA" from the PSAP via the PIF component), it MUST buffer any incoming text packets received from the ESInet until either the "_GA" has been received from the PSAP, or an appropriate period of time has passed without any further text being received from the PSAP. The EAAC Report [22] proposes a value of seven (7) seconds for this timer. Note that, as described above, when the NIF component buffers incoming text packets from the ESInet, it SHALL initiate a provisionable inter-character timer with a default value of 4 seconds, and follow the procedures described above. The NIF component MUST NOT send additional characters to the PIF component until it either detects a "_GA" from the PSAP or the PSAP idle timer has expired (whichever occurs first).

If the NIF component receives a "_GASK" or "_SKSK" indication from the PSAP, the NIF SHALL set the inter-character timer to 1500 ms. If a space, line delimiter or no other characters are received within the 1500 ms time period, and the caller is a TTY caller, the NIF component SHALL pass these characters unchanged toward the caller. If a space, line delimiter or no other characters are received within the 1500 ms time period, and the caller is a RTT caller, the NIF component SHALL send a line delimiter toward the caller, providing handling that is consistent with what would be seen by a caller communicating with an NG9-1-1 PSAP using RTT. If other characters are received from the PSAP within the 1500 ms timer, the characters SHALL be conveyed unchanged to the caller, the NIF component SHALL reset the timer to 7 seconds and the turn will stay with the PSAP.

3.2.2.4.2 Conveyance of SMS/IMS/IM Messages to Legacy PSAPs

As described in Section 3.2.2.4, in support of incoming SMS/MMS/IM text to 9-1-1 messages, once an MSRP session is established with the NIF, the NIF component SHALL send a sequence of 4 space characters in RFC 4103 [10] text with 350 milliseconds of silence between each space character to the PIF component, with five (5) seconds between each sequence, until it receives an RFC 4103 [10] text response from the PIF component. The NIF component SHALL also cache the incoming SMS/MMS/IM text to 9-1-1 message received via MSRP.

Upon determining that the call taker has joined the conversation (via receipt of an appropriate preprogrammed or typed message such as "911 GA" from the PIF component), the NIF component SHALL convert the MSRP message to RFC 4103 [10] characters. The RFC 4103 [10] text characters sent by the NIF component to the PIF component SHALL begin with the characters "Message" followed by the characters from the cached SMS/MMS/IM text message and the characters "_GA". The NIF component SHALL enter idle mode on its egress side and wait for the PIF/call taker to respond. The NIF component SHALL apply the same 4-second "idle timer" to MSRP conversation as it uses for RTT conversation. The NIF remains in active mode on its ingress side. When the NIF component receives RFC 4103 [10] text characters from the PIF component it SHOULD expect "_GA" or "_SKGA", possibly followed by a space or line delimiter (received within 1500 ms) at the end of the text of the message. If this is the case, the NIF component SHOULD replace the "_GA" or "_SKGA" with a line delimiter, and if there is a "Q" immediately preceding the "_GA"/ "_SKGA", it should substitute a "?" for that character. If another character is received within the 1500 ms timer, the characters SHALL be conveyed unchanged toward the caller. The NIF component SHALL implement the same 7-second PSAP idle timer as described above for instances where it does not receive "_GA" or "_SKGA". The NIF component SHALL also apply the same processing as described for RTT upon receipt of an SKSK or GASK from the PSAP.

If the NIF component detects that the caller has sent a subsequent SMS/MMS/IM message (based on receipt of an MSRP message from the ESInet/NGCS), the NIF component MUST buffer the incoming MSRP message until it either receives the RFC 4103 [10] characters "_GA" from the PIF component, or the 7-second PSAP idle timer has expired. The NIF component MUST insert the characters "_GA" at the end of the RFC 4103 [10] text characters (converted from the MSRP message) passed to the PIF component and start buffering any subsequent incoming MSRP messages.

3.2.2.5 Interface to NIF from a Conference Aware UA/Bridge in the ESInet in Support of Transferred Call (Egress LSRG Function)

The NIF component of the egress LSRG SHALL be capable of receiving and processing a SIP INVITE message from a conference aware UA/bridge in the ESInet associated with a call that is being transferred from an i3 PSAP to a PSAP that is served by a legacy SR. The NIF component SHALL be capable of receiving and processing the following information in a SIP INVITE message:

- A From header that contains the conference URI associated with the transferred call (if the transfer models described in Sections 4.7.1.1 or 4.7.2.2 of NENA-STA-010.3 [43] are implemented) or the callback URI (if the transfer model described in Section 4.7.1.3 of NENA-STA-010.3 is implemented)
- A To header that contains the 10-digit number/address associated with the transfer-to PSAP, expressed as a URI (e.g., sos:psap@lsrg or sip:telno@lsrg user=phone) (if the transfer models described in Sections 4.7.1.1 or 4.7.1.2 of NENA-STA-010.3 are implemented) or the digits "911" expressed as a URI or "urn:service:sos" (if the transfer model described in Section 4.7.1.3 of NENA-STA-010.3 is implemented)
- A Request-URI that contains a service URN associated with Selective Transfer (if the transfer models described in Sections 4.7.1.1 or 4.7.1.2 of NENA-STA-010.3 are implemented) or "urn:service:sos" (if the transfer model described in Section 4.7.1.3 of NENA-STA-010.3 is implemented)

- A P-Asserted-Identity header that contains callback information (if the transfer model described in Section 4.7.1.3 of NENA-STA-010.3 is implemented; otherwise the P-Asserted-Identity will not be present and callback information will be obtained from the EIDO)
- A Record Route header containing the URI associated with the conference bridge[18]
- A Route header that contains the 10-digit number/address associated with the transfer-to PSAP, expressed as a URI (e.g., sos:psap@lsrg or sip:telno@lsrg user=phone)
- A Via header identifying the conference bridge[19]
- A Contact header that contains the conference URI and an "isfocus" parameter
- An SDP offer that includes at least the G.711 codec and possibly a media format associated with RTT
- A Call-Info header that contains a URI which, when de-referenced, can be used to access an EIDO.
- A History-Info header, as specified in RFC 7044 [53], with a Reason parameter that includes an indication of why and how the call arrived at the LSRG (i.e., indicating that the call has undergone diversion).
- Other headers as required by RFC 3261 [13].

Subsequent SIP messages (e.g., 100 TRYING, 183 SESSION PROGRESS, 180 RINGING, 200 OK, BYE, ACK) returned by the LSRG in response to a SIP INVITE from a conference bridge associated with a transferred emergency call SHALL be coded as described in RFC 3261 [13], with the following clarification. The NIF component SHALL include a media feature tag with the value "urn:emergency:media-feature.tty-interworking" in the 183 SESSION PROGRESS or 180 RINGING message returned to a conference bridge in response to a SIP INVITE associated with a transferred emergency call.

3.2.2.6 Access to Additional Call Data at Egress LSRG

The egress LSRG may need to access Additional Data structures to populate the non-location fields in the E2 response it sends to an ALI database. To support this function, the NIF component of the egress LSRG SHALL create an association between the Additional Data ("by value" or "by reference") received in the SIP INVITE message from the ESRP and the pANI for the call, and pass the pANI and the associated Additional Data (along with the

[18] If the call traversed one or more ESRPs prior to arriving at the LSRG, additional Record Route headers may be inserted in the INVITE by the ESRPs.

[19] If the call traversed one or more ESRPs prior to arriving at the LSRG, additional VIA headers will be inserted in the INVITE by the ESRPs.

callback information and location information) to the LIF. See Section 3.3.3 for further discussion.

3.3 Location Interwork Function (LIF)

3.3.1 Support for Location Retrieval at Ingress LSRG

To support the routing of emergency calls, and to provide location information to the PSAP to support dispatch, it is necessary for an ingress LSRG to determine the routing and caller location for emergency calls that it receives. For emergency call originations routed via legacy SRs, location is determined based on the 10-digit identifier(s) received with the emergency call (i.e., calling number/ANI for wireline originations, ESRK or "MDN + ESRD" for wireless, or ESQK or "callback number + ESQK" for VoIP). The NIF component SHALL pass the 10-digit identifier(s) received with the emergency call to the LIF component to support location retrieval.

As described in Section 3.2.1, the NIF component SHALL determine which ESInet/NGCS the emergency call is to be routed to by querying an ECRF to obtain the URI of the target ESRP. The LIF component SHALL be responsible for obtaining the caller's routing location to facilitate the query by the NIF to the ECRF. To retrieve the routing location, the LIF component of an ingress LSRG SHALL access provisioned data or a legacy ALI database, as appropriate for the type of origination, using the calling number/ESRK/ESRD/ESQK that it received in incoming signaling from the SR. To obtain caller location, the LIF component SHALL interact with a legacy ALI database. Depending on the type of origination, the legacy ALI may subsequently interact with an MPC/GMLC or VPC in the originating network.

The mechanism used by the LIF for determining routing location will be influenced by the type of emergency origination that is delivered to the LSRG by the legacy SR. It is important to note that both wireline calls and WCM calls will be delivered to the LSRG marked in incoming signaling as "POTS" calls (i.e., the Originating Line Information parameter in the received SS7 IAM is coded "00 – Plain Old Telephone Service [POTS]). Additionally, both wireless and VoIP (i2) NCAS originations are marked in incoming signaling using one of the "wireless" Originating Line Information parameter values. To distinguish a truly wireline call from a wireless or VoIP (i2) origination, the LSRG MUST rely on class of service information returned by the ALI system. In the case of wireless and VoIP (i2) originations, class of service information is returned to the LIF after the ALI system has interacted with an MPC/GMLC or VPC.

If the incoming call is truly a legacy wireline call, the location information provided by the ALI system should be used for both routing and dispatch purposes. For legacy wireless originations, the routing location will be determined based on provisioned data (either within or accessible to the LIF) that maps the ESRD or ESRK to a routing location chosen so that it will route to the primary PSAP that is to receive the call. Caller location associated with legacy wireless originations will be determined via a query from the ALI system to an MPC/GMLC in the originating wireless network which is triggered when the LSRG queries the ALI system. For VoIP (i2) originations, caller location is acquired via a query from the ALI system to a VPC in the originating VoIP (i2) network. Like wireless originations, routing location is determined based on provisioned data that maps the ESQK to a routing location chosen so that it will route to the primary PSAP that is to receive the call.

As described above, an ingress LSRG MUST wait until class of service information is returned by the ALI system before it can determine the type of emergency origination it is dealing with. For all call types except wireline and wireless Phase I (where the Phase I location is stored in the ALI database), the ALI response will not be returned until after the MPC/GMLC or VPC has been queried. To minimize the delay in routing the emergency call, the LIF component of the ingress LSRG MUST first access provisioned data to acquire the routing location for the call. Procedures for acquiring routing and caller location for the various types of emergency originations are described in the subsections below.

3.3.1.1 Legacy Wireline Origination

If the emergency call was originated by a legacy wireline subscriber, the ALI database will contain a static mapping between the Calling Party Number (or Charge Number, depending on local implementation) and the caller's street address, and will provide this location information, along with other information (e.g., class of service), to the ingress LSRG. In the case of a wireline origination, the location information provided by the ALI system should be used for both routing and dispatch purposes. However, since the ingress LSRG cannot unambiguously determine whether an emergency call marked in incoming signaling as "POTS" is truly a wireline call until after the ALI response is received, the LIF component of the LSRG SHALL first access provisioned data to determine the routing location for the call. Depending on the implementation, the routing location associated with a wireline origination SHOULD be determined by the LIF in one of two ways, depending on how the data is provisioned. One alternative is to only populate mappings associated with ESRKs/ESRDs/ESQKs so that when the LIF consults the provisioned data with a Calling Party Number/Charge Number, and it does not find a mapping, it knows it SHOULD query the ALI system and SHOULD use the location in the ALI response as the routing and caller location.

Alternatively, mappings associated with Calling Party Numbers/Charge Numbers could be included in the provisioned data (with the mapped location identical to the location populated in the ALI database). Using this approach, the LIF SHOULD determine routing location via provisioned data for all call types, and SHOULD query the ALI system for caller location to support dispatch.

To acquire location information from a legacy ALI system, the LIF component of the ingress LSRG is REQUIRED to support an interface that will allow it to query the legacy ALI database using the 10-digit number provided to it by the NIF component as the query key. The LIF SHALL be capable of querying an ALI database for location information using the query format described in Section 3.2.1.2.1.1 of NENA-STA-027 [7], or Sections 2.4.1 and 3.2.3.2 of NENA 04-005 [8], or a local variant of these standards, based on agreements with the legacy ALI database provider.

The LIF SHALL be capable of receiving and processing an ALI response message using the same protocol as was used in generating the ALI request. If the LIF generates an ALI request formatted as described in Section 3.2.1.2.1.1 of NENA-STA-027 [7], it SHALL be capable of receiving and processing an ALI response based on Section 3.2.1.2.2.1 of NENA-STA-027 [7]. If the LIF generates an ALI request formatted as described in Sections 2.4.1 and 3.2.3.2 of NENA 04-005 [8], the LIF SHALL be capable of receiving and processing an ALI response based on Sections 2.4.2 and 3.2.3.4 of NENA 04-005 [8]. If, based on agreements with the legacy ALI database provider, the LIF generates an ALI query that is a modified version of a standard ALI request as defined in NENA-STA-027 [7] or NENA 04-005 [8], the LIF SHALL be capable of receiving and processing an ALI response formatted based on agreements with the ALI database provider.

In the case of legacy wireline originations, the routing location determined via the provisioned data or returned by the ALI system (based on implementation) is expected to be in MSAG-valid civic format. Before passing the civic location to the NIF component, the LIF component MUST interact with the MSAG Conversion Service (MCS) to obtain a PIDF-LO that contains the civic location information. The LIF SHALL then pass the routing location formatted as a PIDF-LO to the NIF component, and the NIF component will extract the location from the PIDF-LO for use in querying the ECRF. The LIF SHALL also format and pass the location information returned by the ALI system to the NIF for delivery to the target PSAP in support of dispatch. (Since the routing and caller location will be the same for a wireline origination, whether the LIF passes the data as a single location or separately as routing and caller location is an implementation decision.) The LIF SHALL also pass an indication that the "Service Delivered by Provider to End User" is "POTS" to the NIF component. In addition, the LIF SHALL pass non-location information obtained from the ALI system (e.g., class of service, NENA Company ID) to the NIF component.

3.3.1.2 Legacy Wireless Originations

An emergency call that is originated by a legacy wireless caller may be delivered to an ingress LSRG marked either as a POTS call (if delivered to the SR using WCM) or as a wireless call (if delivered to the SR using NCAS). In any case, the LIF component SHALL consult provisioned data (using the ESRK or ESRD provided to it by the NIF) to acquire the routing location for the call, and SHALL consult the ALI system to obtain caller location for the call.

Specifically, if the call is a Phase I wireless emergency call for which a static caller location estimate is stored locally in the ALI system (i.e., no query is launched to the MPC/GMLC), the LIF SHALL obtain the routing location by accessing provisioned data that maps the ESRD to a routing location that is chosen so that it will route to the primary PSAP that is to receive the call. The LIF SHALL obtain the caller location for the call by querying the ALI database for the static location value that is associated with the cell site/sector. The LIF SHALL then pass the routing location, along with an indication that the "Service Delivered by Provider to End User" is "wireless" to the NIF component. The LIF SHALL also pass a SIP or HTTP-Enabled Location Delivery (HELD) location reference to the NIF that uniquely identifies the location information and the LSRG. The LIF SHALL associate the location reference with the routing and caller location. The LIF SHALL also pass whatever non-location information it received from the ALI system (e.g., class of service, NENA Company ID) to the NIF component.

If the call is a wireless Phase 2 emergency call (or a Phase 1 wireless emergency call using a WCM implementation), the LIF SHALL access provisioned data that maps the location key (i.e., ESRK or ESRD) provided with the call to a routing location chosen so that it will route to the target PSAP associated with the ESRK/ESRD. The LIF SHALL query the ALI system for caller location using the ESRK or "MDN + ESRD" received from the NIF component. As for wireline originations, the LIF component SHALL query the ALI system using the query format described in Section 3.2.1.2.1.1 of NENA-STA-027 [7], or Section 2.4.1 and 3.2.3.2 of NENA 04-005 [8], or a local variant of these standards, based on agreements with the legacy ALI database provider. (The ALI system is expected to query an MPC/GMLC in the wireless originating network for the caller location information.) The LIF SHALL be capable of receiving and processing an ALI response message using the same protocol as was used in generating the ALI request. The LIF component SHALL immediately return the routing location to the NIF component, along with an indication that the "Service Delivered by Provider to End User" is "wireless." The LIF SHALL also pass a SIP or HELD location reference to the NIF that uniquely identifies the location information and the LSRG**.** Upon receiving the caller location returned by the ALI system (which is initially expected to convey information about the location of the cell site/sector), the LIF component SHALL retain the caller location and associate it with the location reference**.** The LIF component SHALL also pass any non-location information received in the ALI response to the NIF component.

3.3.1.3 Originations from i2 VoIP Originating Networks

An emergency origination from an i2 VoIP originating network may be delivered to a legacy SR with the ESQK only (using the WCM approach) or with "callback number + ESQK" (using the wireless NCAS approach). The NIF component in the ingress LSRG SHALL pass the ESQK or the "callback number + ESQK" to the LIF component to support location retrieval. The LIF SHALL access provisioned data that maps the ESQK provided with the call to a routing location chosen so that the call will route to the target PSAP associated with the ESQK. The LIF SHALL query the ALI system to obtain the caller location associated with the ESQK received from the NIF component. The LIF component SHALL query the ALI system using the query format described in Section 3.2.1.2.1.1 of NENA-STA-027 [7], or Section 2.4.1 and 3.2.3.2 of NENA 04-005 [8], or a local variant of these standards, based on agreements with the legacy ALI system provider. (The ALI system is expected to query a VPC in the i2 VoIP originating network for the caller location information.) The LIF SHALL be capable of receiving and processing an ALI response message using the same protocol as was used in generating the ALI request. The LIF component SHALL immediately return the routing location to the NIF component, along with an indication that the "Service Delivered by Provider to End User" is "VoIP." (See RFC 7852 [14].) The LIF SHALL also pass a SIP or HELD location reference to the NIF that uniquely identifies the location record and the LSRG**.** Upon receiving the caller location returned by the ALI system (which in case of an i2 VoIP origination is not expected to change for the duration of the call), the LIF component SHALL retain the caller location and associate it with the location reference**.** The LIF component SHALL also pass any non-location information received in the ALI response to the NIF component.

3.3.1.4 Support for Location Dereferencing

Since an ingress LSRG may provide a location reference (e.g., associated with a legacy wireless or i2 VoIP emergency call origination) in the INVITE that it sends to the ESRP, the LIF MUST also support the dereferencing of location references by external elements (e.g., ESRPs, LPGs, egress LSRGs, PSAPs). The LIF MUST support SIP and**/**or HELD dereferencing protocols, and MUST be capable of applying the appropriate one based on the format of the location reference provided as output from the location retrieval process. Location-by-reference using SIP is an implied subscription to Presence, as described in RFC 3856 [27]. An element needing location that has a SIP location URI must issue a SIP SUBSCRIBE, per RFC 3265 [28], to the location URI. Filters may be used to control notification, as described in RFC 4661 [29], RFC 6446 [30], and RFC 6447 [31].

If the location reference generated by the LIF contains a HELD location URI, the LIF SHALL support the dereferencing procedures specified in RFC 6753 [32].

Credentials MAY be used by the LIF to authorize delivery of caller location, with the required confidence/uncertainty information (when geodetic location is supplied) or civic/sub-civic address-level information (when civic location is supplied), when requested by a PSAP or other authorized entities

3.3.1.4.1 Interworking Between HELD and ALI Protocols

The following tables illustrate the interworking between HELD and the ALI query protocols described in NENA-STA-027 [7] and NENA 04-005 [8] to support location dereferencing.

Table 3-1 HELD locationRequest to ALI (NENA-STA-027 [7]**) Request Mapping**

HELD locationRequest	ALI Request	Notes
locationURI	-	Reflects value provided in the Geolocation header field of the INVITE message sent by the ingress LSRG
locationType	-	May include the optional "exact" attribute and indicates "civic" and/or "geodetic"
responseTime	-	The HELD responseTime parameter indicates the purpose for which the location is being requested (i.e., "emergencyRouting" or "emergencyDispatch") and the amount of time the requesting entity is willing to wait for a response. Only HELD locationRequests with a responseTime of "emergencyDispatch" will be mapped to an ALI (NENA-STA-027 [7]) request message.
-	NPA	Populated with the NPA of the query key (i.e., calling number/ANI, pANI [ESRK, ESRD, ESQK])

HELD locationRequest	ALI Request	Notes
-	NXX	Populated with the NXX of the query key (i.e., calling number/ANI, pANI [ESRK, ESRD, ESQK])
-	LINE	Populated with the XXXX of the query key (i.e., calling number/ANI, pANI [ESRK, ESRD, ESQK])
-	POS	Two digits given by the PSAP equipment to identify the position associated with the request. In queries from ingress LSRGs, this field will be populated with the value "00".
	TRK	Two digits given by the PSAP equipment to identify the trunk number over which the call was received. For ingress LSRGs, the value "00" should be used.
	CHECK	One digit checksum to verify the integrity of the message. The value of this digit is calculated such that when it is added to the sum of the previous digits, the total sum is evenly divisible by 8.
	CR	Carriage Return character (hex 0D) inserted by the PSAP equipment to signal the end of the request.

Table 3-2 ALI (NENA-STA-027 [7]**) Response to HELD locationResponse Mapping**

ALI Response	HELD locationResponse	Notes
STX	-	One character (hex 02) which represents a 'start of message' signal
TYPE	-	One digit indicating the response type 1 (hex 31) = Only one ALI link operational 2 (hex 32) = Two ALI links operational 9 (hex 39) = ALI record not found
POS	-	Same value as in query (i.e., "00")
Text	presence	The ALI text length and format SHALL be negotiated by the database provider, CPE vendor, CAD vendor and their customer prior to the installation. [The limit of 511 characters in NENA 04-001, Issue 2 has been removed.] For type 9 messages, the text portion of the response is of the form "NPA-NXX-TN No Record Found". The LIF component of the LSRG SHALL map location information received in the text portion of the ALI response to civic and/or geodetic location populated in a PIDF-LO in the HELD locationResponse.
ETX	-	One character (hex 03) which represents an 'end of message' signal

Table 3-3 HELD locationRequest to ALI (NENA 04-005 [8]) Request Mapping

HELD locationRequest	ALI Request	Notes
locationURI	-	Reflects value provided in the Geolocation header field of the INVITE message sent by the ingress LSRG
locationType	-	May include the optional "exact" attribute and indicates "civic" and/or "geodetic"
responseTime	-	The HELD responseTime parameter indicates the purpose for which the location is being requested (i.e., "emergencyRouting" or "emergencyDispatch") and the amount of time the requesting entity is willing to wait for a response. Only HELD locationRequests with a responseTime of "emergencyDispatch" will be mapped to an ALI (NENA 04-005 [8]) request message.
-	Version (optional)	Carries the version of the validating schema
-	ID (optional)	Carries a message identifier

HELD locationRequest	ALI Request	Notes
-	QueryType	Populated with: urn:nena-org:dtc:aqs:request:Rebid associated with a responseTime of "emergencyDispatch" or urn:nena-org:dtc:aqs:request:Refresh, if a service provider can process rebid (retransmit) and refreshed queries differently, for example, if a refresh query is used to return only updated XML ALI location data instead of a complete XML ALI
-	QueryKey	Populated with the NPA-NXX-XXXX of query key (i.e., calling number/ANI, pANI [ESRK, ESRD, ESQK])

Table 3-4 ALI (NENA 04-005 [8]) Response to HELD locationResponse Mapping

ALI Response	HELD locationResponse	Notes
Version (optional)	-	Carries the version of the validating schema
ID (optional)	-	Carries a message identifier
inResponseTo (optional)	-	References the associated request message

ALI Response	HELD locationResponse	Notes
Status – Status Code – Status Message (optional) – – Status Details (optional)	- - -	urn:nena-org:dtc:aqs:status:Ok urn:nena-org:dtc:aqs:status:OkMore urn:nena-org:dtc:aqs:status:OkPorting urn:nena-org:dtc:aqs:status:OkMigrate urn:nena-org:dtc:aqs:status:Requester urn:nena-org:dtc:aqs:status:Responder urn:nena-org:dtc:aqs:status:VersionMismatch urn:nena-org:dtc:aqs:status:RequestRefused urn:nena-org:dtc:aqs:status:DuplicateRequest urn:nena-org:dtc:aqs:status:NotFound urn:nena-org:dtc:aqs:status:ANIFailure911 urn:nena-org:dtc:aqs:status:ANIFailure000 urn:nena-org:dtc:aqs:status:AnonymousCall Carries textual status information Can carry any XML structured information

ALI Response	HELD locationResponse	Notes
QueryResultData	presence	A NENA XML ALI body (ALIBody) mapped to civic and/or geodetic location populated in a PIDF-LO
QueryKey	-	Required in responses to failed requests, otherwise optional. It contains the exact contents of the corresponding query message element for the failed request

3.3.1.4.2 Interworking Between SIP Presence and ALI Protocols

The following tables illustrate the interworking between SIP Presence and the ALI query protocols described in NENA-STA-027 [7] and NENA 04-005 [8] to support location dereferencing.

Table 3-3 SIP SUBSCRIBE to ALI (NENA-STA-027 [7]**) Request Mapping**

SIP SUBSCRIBE	ALI Request	Notes
location URI (in Request-URI and To:)	-	Reflects value provided in the Geolocation header field of the INVITE message sent by the ingress LSRG
Filter (in body)	-	MAY include rate filters and/or location filters
-	NPA	Populated with the NPA of the query key (i.e., calling number/ANI, pANI [ESRK, ESRD, ESQK])

SIP SUBSCIRBE	ALI Request	Notes
-	NXX	Populated with the NXX of the query key (i.e., calling number/ANI, pANI [ESRK, ESRD, ESQK])
-	LINE	Populated with the XXXX of the query key (i.e., calling number/ANI, pANI [ESRK, ESRD, ESQK])
-	POS	Two digits given by the PSAP equipment to identify the position associated with the request. [20]
	TRK	Two digits given by the PSAP equipment to identify the trunk number over which the call was received. For ingress LSRGs, the value "00" should be used.
	CHECK	One digit checksum to verify the integrity of the message. The value of this digit is calculated such that when it is added to the sum of the previous digits, the total sum is evenly divisible by 8.
	CR	Carriage Return character (hex 0D) inserted by the PSAP equipment to signal the end of the request.

Table 3-4 ALI (NENA-STA-027 [7]**) Response to SIP NOTIFY Mapping**

[20] The LSRG should populate this value in such a way as to allow for multiple simultaneous ALI queries.

ALI Response	SIP NOTIFY	Notes
STX	-	One character (hex 02) which represents a 'start of message' signal
TYPE	-	One digit indicating the response type 1 (hex 31) = Only one ALI link operational 2 (hex 32) = Two ALI links operational 9 (hex 39) = ALI record not found
POS	-	Same value as in query
Text	presence	The ALI text length and format SHALL be negotiated by the database provider, CPE vendor, CAD vendor and their customer prior to the installation. [The limit of 511 characters in NENA 04-001, Issue 2 has been removed.] For type 9 messages, the text portion of the response is of the form "NPA-NXX-TN No Record Found". The LIF component of the LSRG SHALL map location information received in the text portion of the ALI response to civic and/or geodetic location populated in a PIDF-LO in the HELD locationResponse.
ETX	-	One character (hex 03) which represents an 'end of message' signal

Table 3-7 SIP SUBSCRIBE to ALI (NENA 04-005 [8]) Request Mapping

SIP SUBSCRIBE	ALI Request	Notes
location URI (in Request-URI and To:)	-	Reflects value provided in the Geolocation header field of the INVITE message sent by the ingress LSRG
Filter (in body)	-	MAY include rate filters and/or location filters
-	Version (optional)	Carries the version of the validating schema
-	ID (optional)	Carries a message identifier
-	QueryType	Will initially be populated with: urn:nena-org:dtc:aqs:request:Normal Depending on filters included in the SUBSCRIBE, subsequent ALI requests may be populated with: urn:nena-org:dtc:aqs:request:Rebid” or urn:nena-org:dtc:aqs:request:Refresh, if a service provider can process rebid (retransmit) and refreshed queries differently, for example, if a refresh query is used to return only updated XML ALI location data instead of a complete XML ALI
-	QueryKey	Populated with the NPA-NXX-XXXX of query key (i.e., calling number/ANI, pANI [ESRK, ESRD, ESQK])

Table 3-8 ALI (NENA 04-005 [8]**) Response to SIP NOTIFY Mapping**

ALI Response	SIP NOTIFY	Notes
Version (optional)	-	Carries the version of the validating schema
ID (optional)	-	Carries a message identifier
inResponseTo (optional)	-	References the associated request message

ALI Response	SIP NOTIFY	Notes
Status – Status Code	-	urn:nena-org:dtc:aqs:status:Ok urn:nena-org:dtc:aqs:status:OkMore urn:nena-org:dtc:aqs:status:OkPorting urn:nena-org:dtc:aqs:status:OkMigrate urn:nena-org:dtc:aqs:status:Requester urn:nena-org:dtc:aqs:status:Responder urn:nena-org:dtc:aqs:status:VersionMismatch urn:nena-org:dtc:aqs:status:RequestRefused urn:nena-org:dtc:aqs:status:DuplicateRequest urn:nena-org:dtc:aqs:status:NotFound urn:nena-org:dtc:aqs:status:ANIFailure911 urn:nena-org:dtc:aqs:status:ANIFailure000 urn:nena-org:dtc:aqs:status:AnonymousCall
– Status Message (optional) –	-	Carries textual status information
– Status Details (optional)	-	Can carry any XML structured information

ALI Response	SIP NOTIFY	Notes
QueryResultData	presence	A NENA XML ALI body (ALIBody) mapped to civic and/or geodetic location populated in a PIDF-LO
QueryKey	-	Required in responses to failed requests, otherwise optional. It contains the exact contents of the corresponding query message element for the failed request

3.3.2 Support for ESN Determination at Egress LSRG

As described in Section 3.2.2.1, if the NIF cannot determine the ESN based on the incoming SIP INVITE message from the ESRP, it SHALL pass the received location information and Additional Data (by-reference) to the LIF component and use the ESN value obtained by the LIF.

- The LIF determines if it received an ESN Additional Data block from the NIF by examining the Call-Info header fields provided by the NIF. If any contain a 'Purpose' value of "EmergencyCallData.LegacyESN", it is conveying an ESN Additional Data block. If the URI scheme is "CID", the ESN Additional Data block is being conveyed by value and is contained in the body of the message. If the URI scheme is "HTTPS", the ESN Additional Data block is being conveyed by reference.
- If the LIF receives an ESN Additional Data block by-reference from the NIF, the LIF SHALL send a de-reference request to the Additional Data Repository (ADR) identified in the reference URI contained in the Call-Info header field provided by the NIF. (See Section 3.3.3.3 for further details.) If the dereference is successful, the LIF SHALL send the received ESN value to the NIF component to be used as the ESN for the call.
- If the LIF does not obtain an ESN Additional Data block, and the location information received directly from the NIF component (i.e., because location was delivered by the ESRP to the NIF component "by value") or obtained by the LIF component by de-referencing the location reference URI received from the NIF is a civic location, the LIF component of the LSRG SHALL utilize the PIDFLOtoMSAG function of the MSAG Conversion Service described in Section 4.4 of NENA-STA-010.3 [43] to obtain the appropriate ESN value for the call based on the PIDF-LO (containing the civic location) provided in the query. The response from the MSAG

Conversion Service will also contain the MSAG-valid format of the civic location information contained in the PIDF-LO.

- If the LIF does not obtain an ESN Additional Data block, and the location information associated with the emergency call is a geodetic location, the LIF component SHALL first reverse-geocode the location by interacting with a Geocode Service (GCS) that takes the PIDF-LO containing the geodetic location and returns a PIDF-LO that contains a civic address for the same location. The LIF component SHALL then use the civic location returned by the Geocode Service (GCS) to interact with the MSAG Conversion Service, invoking the PIDFLOtoMSAG function, to obtain the ESN value for the call. Note that while the responses from the GCS and the MSAG Conversion Service will contain civic location, the LIF component SHALL populate the original geodetic location in the response to an E2 request from an ALI system.

The LIF component SHALL pass the ESN value obtained from an ESN Additional Data block or from the MSAG Conversion Service (as appropriate) to the NIF component.

3.3.3 Support for Location Requests from ALI Databases at Egress LSRG

For emergency calls routed to an egress LSRG via the ESInet/NGCS, the NIF component SHALL retain the callback information, location information and Additional Data received in incoming signaling and associate an ESN-appropriate pANI with that information. The NIF component SHALL pass the pANI and the associated callback information, location information, and Additional Data to the LIF to support location requests from legacy ALI databases. As described above, if the Additional Data and/or the location information provided by the NIF component is "by-reference", the LIF component will have to apply a de-referencing operation, as described in Section 3.3.3.3.

If the PIDF-LO returned in response to the location de-reference request contains civic location information, the LIF MUST interact with the MSAG Conversion Service to obtain the ESN and the MSAG-valid form of that civic location to include in the response to the location request from the ALI database. If the LIF does not receive a response from the MSAG Conversion Service (within a provisioned period of time), the LIF SHALL respond with an error indication when queried by the ALI system. If the LIF receives an indication from the MSAG Conversion Service that the conversion to an MSAG-valid civic location is incomplete, the LSRG SHALL populate the available information in the response to the ALI system. If the LIF does not receive an ESN in the response from the MSAG Conversion Service and, based on the protocol used by the ALI system to query the LIF an ESN is expected in the response, the LIF SHALL populate the ESN field of the response to the ALI based on per-LSRG provisioning.

To support location delivery to legacy PSAPs (via an ALI system) on call originations that are routed via an ESInet/NGCS, an egress LSRG MUST support an E2 interface, as defined in NENA-STA-018.2-2021 (originally NENA 05-001) [5] to support queries from interconnected ALI systems. The LSRG MAY also need to support a PSAP to ALI Message (PAM) interface, if it interconnects with ALI databases that use PAM to obtain location for legacy wireless emergency calls today. Support for a PAM interface will be based on agreements between the LSRG provider and the ALI database provider. (See Section 3.3.3.1 for further details.) The location key used in the E2/PAM query will be the pANI created by the egress LSRG for the emergency call.

3.3.3.1 Support for PAM Interface

The LIF component of the LSRG MAY need to support a PAM interface if it interconnects with ALI databases that use PAM to obtain location for legacy wireless emergency calls today. Use of the PAM protocol to query the LIF component for location information will be based on prior agreements between the LSRG provider and the ALI database provider. If PAM is to be used by the ALI database for location retrieval, details related to the population of PAM queries/responses will have to be obtained directly from the ALI database provider. Note that the location key used in the PAM query will be the pANI created by the NIF component of the LSRG for the emergency call.

3.3.3.2 Support for the E2 Interface

There are four Request/Response messages defined in in NENA-STA-018.2-2021 (originally NENA 05-001) [5] that are REQUIRED here for use by the LIF component of the LSRG in receiving and responding to requests for location and other emergency call information from legacy ALI databases. The remainder of this section details the four messages that make up communication across the E2 interface.

3.3.3.2.1 Emergency Services Position Request (ESPOSREQ)

The LIF component of an egress LSRG SHALL be capable of receiving and recognizing an Emergency Services Position Request (ESPOSREQ) message from the ALI database as a request for call and location-related information for an emergency call, identified by the pANI created by the NIF component (possibly in combination with the callback number). The LIF component SHALL support the valid parameters for the ESPOSREQ message shown in Table 3-9.

Table 3-9. ESPOSREQ Parameters

Parameter	**§ Ref. in NENA-STA-018.2-2021** [5]	**Condition**	**Description/Value**
Package Type=Query with Permission	9.1.1	Mandatory	Query with Permission
Transaction ID	9.1.2	Mandatory	As in NENA-STA-018.2-2021 [5]
Component Sequence	9.2.1	Mandatory	As in NENA-STA-018.2-2021 [5]
Component Type	9.2.2	Mandatory	Invoke (Last)
Component ID	9.2.3	Mandatory	As in NENA-STA-018.2-2021 [5]
Operation Code	9.2.4	Mandatory	Private TCAP
Parameter Set	9.2.7	Mandatory	As in NENA-STA-018.2-2021 [5]
ESMEIdentification	9.3.1	Mandatory	Identifies the requesting ALI database
Position Request Type	9.3.2	Mandatory	Identifies whether this is the initial request for location or an update request
Emergency Services Routing Key (esprKey)	9.3.3	Optional[a]	If present, this parameter will contain pANI created by the NIF component
Callback Number	9.3.4	Optional[b]	This parameter will be present in the

Parameter	**§ Ref. in NENA-STA-018.2-2021** [5]	**Condition**	**Description/Value**
			request from the legacy ALI database to the LIF component of the LSRG if provided to the PSAP in call setup signaling.
Emergency Services Routing Digits	9.3.6	Optional[c]	If present, this parameter will contain the pANI created by the NIF component

a. This parameter is Optional in NENA-STA-018.2-2021 [5] for wireless call information provided to the Emergency Services Message Entity (ESME) from the MPC. When the E2 interface is used by a legacy ALI database to request location/call information from a LIF component, and this parameter is present, it MUST be populated with the pANI created by the NIF component.

b. This parameter is Optional in NENA-STA-018.2-2021 [5] for wireless call information provided to the ESME from the MPC. The callback number SHALL be populated in the ESPOSREQ message if the legacy SR and PSAP support the delivery of both a callback number and a pANI in call setup signaling.

c. This parameter is Optional in NENA-STA-018.2-2021 [5] for wireless call information provided to the ESME from the MPC. When the E2 interface is used by a legacy ALI database to request location/call information from a LIF component, this parameter MAY be populated, as determined by the associated ALI database record. If present, this parameter MUST be populated with the pANI created by the NIF component.

3.3.3.2.2 Emergency Services Position Request Response (esposreq)

The esposreq message is sent from the LIF component of an egress LSRG to the ALI database to inform the ALI database of the position of the calling device. This response is used when the LIF component recognizes the pANI and can retrieve the call and location associated data for that call. Note that if the location information associated with the pANI is a location-by-reference, the LIF component MUST first perform a de-referencing operation using the interface defined in Section 3.3.3.3, to obtain the location information to populate in the esposreq message. The LIF component MAY also have to obtain non-location information from an Additional Data structure, if necessary, to populate the non-location-related fields in the esposreq. The LIF component SHALL follow the procedures described in Sections 3.2.2.6 and 3.3.3.3 for accessing the appropriate Additional Data structure(s).

The LIF component shall support the valid parameters for the esposreq message shown in Table 3-10.

Table 3-10. esposreq Parameters

Parameter	**§ Reference in NENA-STA-018.2-2021** [5]	**Inclusion Condition**	**Description/Value**
Package Type	9.1.1	Mandatory	Response
Transaction ID	9.1.2	Mandatory	As in NENA-STA-018.2-2021 [5]
Component Sequence	9.2.1	Mandatory	As in NENA-STA-018.2-2021 [5]
Component Type	9.2.2	Mandatory	Return Result (Last)
Component ID	9.2.3	Mandatory	As in NENA-STA-018.2-2021 [5]

Parameter Set	9.2.7	Mandatory	As in NENA-STA-018.2-2021 [5]
Position Result	9.3.8	Mandatory	As in NENA-STA-018.2-2021 [5]
PositionInformation	9.3.9		As in NENA-STA-018.2-2021
Generalized Time	9.3.10.1	Optional	As in NENA-STA-018.2-2021 [5]
Geographic Position	9.3.10.2	Optional[a]	Geolocation
Position Source	9.3.10.3	Optional	Method of location determination
Generalized Time	9.3.11	Optional	Date/Time Stamp for time of allocation of the pANI by the NIF component
Callback Number	9.3.5	Conditional[b]	Caller's E.164 number
Emergency Services Routing Digits Request Response	9.3.7 (for format)	Optional[d]	pANI allocated by the NIF component
MobileIdentificationNumber	9.3.12	NA	Not used
InternationalMobileSubscriberIdentity (IMSI)	9.3.13	NA	Not used
MobileCallStatus	9.3.14	NA	Not used
CompanyID	9.3.15	Optional[c]	Name of the Originating Service Provider (up to 15 characters)

LocationDescription	9.3.16	Optional[a]	As in NENA-STA-018.2-2021 [5]

a. One or the other of the PositionInformation-Geographic Position or the LocationDescription parameters MUST be populated with geolocation and civic address, respectively. Both MAY be populated, if both are available at the LIF component. Civic addresses returned in the LocationDescription parameter MUST be in MSAG-valid format.

b. This parameter is Optional in NENA-STA-018.2-2021 [5] for wireless call information provided to the ESME from the MPC. However, when the E2 interface is used to deliver call/ location information to a legacy ALI database, this parameter MUST be populated with an E.164 number identifying the Callback Number of the emergency caller, if it is available to the LIF component of the LSRG.

c. This parameter is Optional in NENA-STA-018.2-2021 [5] for wireless call information provided to the ESME from the MPC. However, when the E2 interface is used to deliver call/ location information to a legacy ALI database, this parameter SHOULD be populated with the name of the originating service provider, if it is available to the LIF component of the LSRG.

d. This parameter is Optional in NENA-STA-018.2-2021 [5] for wireless call information provided to the ESME from the MPC. If this parameter is included in the esposreq message when the E2 interface is used to support the delivery of call/location information to a legacy ALI database, this parameter SHALL be populated with the pANI that was generated by the NIF component.

3.3.3.2.3 Emergency Services Position Request Response Return Error

The LIF component of an egress LSRG SHALL support the Emergency Service Position Request Response Return Error message, including the parameters listed in Table 3-11. This message is sent from the LIF component of the LSRG to the ALI database to inform the ALI database that the requested action was not performed. The Error Code contains the reason for failure. No new error codes have been identified for this application.

Table 3-11. Emergency Services Position Request Response Return Error Parameters

Parameter	**§ Reference in NENA-STA-018.2-2021** [5]	**Condition**	**Description/Value**
Package Type	9.1.1	Mandatory	Response
Transaction ID	9.1.2	Mandatory	As in NENA-STA-018.2-2021 [5]
Component Sequence	9.2.1	Mandatory	As in NENA-STA-018.2-2021 [5]
Component Type	9.2.2	Mandatory	Return Error
Component ID	9.2.3	Mandatory	As in NENA-STA-018.2-2021 [5]
Error Code	9.2.5	Mandatory	Error condition: reason for failure
Parameter Set	9.2.7	Mandatory	Empty

3.3.3.2.4 Emergency Services Position Request Response Reject

This message is sent from the LIF component of an egress LSRG to the ALI database to inform the ALI database that the invoke message contains a Transaction or Component Level protocol error. The LIF component of the LSRG SHALL support the Emergency Service Position Request Response Reject message, including the parameters listed in Table 3-12. The Problem Code describes the nature of the protocol error. No new Problem Codes have been identified for this application.

Table 3-12. Emergency Services Position Request Response Reject Parameters

Parameter	**§ Reference in NENA-STA-018.2-2021** [5]	**Condition**	**Description/Value**
Package Type	9.1.1	Mandatory	Response
Transaction ID	9.1.2	Mandatory	As in NENA-STA-018.2-2021 [5]
Component Sequence	9.2.1	Mandatory	As in NENA-STA-018.2-2021 [5]
Component Type	9.2.2	Mandatory	Reject
Component ID	9.2.3	Mandatory	As in NENA-STA-018.2-2021 [5]
Problem Code	9.2.6	Mandatory	As in NENA-STA-018.2-2021 [5]
Parameter Set	9.2.7	Mandatory	Empty

3.3.3.2.5 E2 Parameter Definitions

- ESME Identification - This parameter identifies the ALI database that originated the ESPOSREQ message. The LIF component of an egress LSRG SHALL be capable of receiving and processing an ESMEIdentification parameter in an ESPOSREQ message that is populated with the identification of the ALI database that is requesting the location information
- Position Information - Geographic Position Parameter - If geolocation (i.e., coordinate-based location) information is provided to the LSRG in incoming SIP signaling associated with the emergency call or as the result of a de-referencing operation, the LIF component of the LSRG SHALL use the content of the geolocation information to populate the Position Information – Geographic Position Parameter in the esposreq message. The LSRG SHALL include at most one geodetic location in the esposreq message. The content of the geolocation information SHALL be mapped to the E2 interface Geographic Position parameter described in Section 9.3.10.3 of NENA-STA-018.2-2021 [5], subject to these additional requirements.

  - If the geolocation object information does not include altitude or uncertainty parameters, the LIF component SHALL use the Type of Shape and Shape description corresponding to Ellipsoid Point.
  - If the geolocation object information includes uncertainty but not altitude, the LIF component SHALL use the Type of Shape and Shape description corresponding to Ellipsoid Point with Uncertainty.
  - If the geolocation object information includes altitude, the LIF component SHALL use the Type of Shape and Shape description corresponding to Ellipsoid Point with Altitude and Uncertainty. If altitude is included without uncertainty/confidence values, the value of K for the uncertainty code and confidence SHALL be populated with "0" to indicate no information.
  - The degrees of latitude SHALL be used to populate the Degrees of Latitude in the Shape description parameter. The LIF component SHALL code this parameter with decimal degrees of latitude using WGS84 on the E2 interface.
  - The degrees of longitude SHALL be used to populate the Degrees of Longitude in the Shape description parameter. The LIF component SHALL code this parameter with decimal degrees of longitude using WGS84 on the E2 interface.

- Position Information - Position Source Parameter - The Position Source parameter is populated from data received in the Method parameter of the PIDF-LO. If the LIF component receives both geolocation and civic location information in the same PIDF-LO, the contents of the Method parameter in the PIDF-LO are assumed to apply to both types of location elements, and so will be populated as the Position Source corresponding to the geolocation and the civic location. If a Method parameter was not included, then the Position Source parameter should be populated with the value corresponding to Unknown (0). The LIF component of the LSRG SHALL support the Position Source values specified in Table 3-13.

Table 3-13. Mappings of Method Token Values of the PIDF-LO to Codings of the Position Source Parameter in the esposreq Message

Location Object parameter (PIDF-LO: "Method token"* Value)**	**Position Source parameter value**	**Position Source parameter value meaning**
<Not provided in PIDF-LO>	0	unknown
best-guess	0	unknown
Manual	0	unknown
ELS-BLE	0	unknown
ELS-WiFi	0	unknown
NEAD-BLE	0	unknown
NEAD-WiFi	0	unknown
Derived	1	networkUnspecified
DHCP	1	networkUnspecified
LLDP-MED	1	networkUnspecified
MPL	1	networkUnspecified
NMR	1	networkUnspecified
RFID	1	networkUnspecified
RSSI	1	networkUnspecified
RSSI-RTT	1	networkUnspecified
RTT	1	networkUnspecified
Wiremap	1	networkUnspecified
802.11	1	networkUnspecified

Location Object parameter (PIDF-LO: "Method token"*** Value)	Position Source parameter value	Position Source parameter value meaning
AOA	2	networkAOA
Triangulation	3	networkTOA
networkTOA	3	networkTOA
networkTDOA	4	networkTDOA
UTDOA	4	networkTDOA
networkRFFingerprinting	5	networkRFFingerprinting
Cell	6	networkCellSector
E-CID	6	networkCellSector
TA	7	networkCellSectorwithTiming
TA-NMR	7	networkCellSectorwithTiming
IPDL	16	handsetUnspecified
GPS	17	handsetGPS
A-GPS	18	handsetAGPS
Device-Assisted_A-GPS	18	handsetAGPS
Device-Based_A-GPS	18	handsetAGPS
Device-Assisted_EOTD	19	handsetEOTD
Device-Based_EOTD	19	handsetEOTD
Handset_AFLT	20	handsetAFLT

Location Object parameter (PIDF-LO: "Method token"* Value)**	**Position Source parameter value**	**Position Source parameter value meaning**
Handset_EFLT	21	handsetEFLT
GNSS	22	handsetGNSS
A-GNSS	23	handsetAGNSS
OTDOA	24	handsetOTDOA
MBS	25	handsetTBS
Handset_WiFi*	26	handsetWi-Fi
Handset_BLE*	27	handsetBluetooth
Hybrid_A-GPS	32	hybridUnspecified
hybridCellSector_AGPS	32	hybridUnspecified
hybridAGPS_AFLT	33	hybridAGPS_AFLT
hybridCellSector_AFLT*	34	hybridCellSector_AFLT
hybridTDOA_AOA	35	hybridNetworkTDOA_AOA
hybridTDOA_AGPS	36	hybridNetworkTDOA_AGPS
hybridTDOA_AGPS_AOA	37	hybridTDOA_AGPS_AOA
hybridOTDOA_AGPS**	38	hybridAGPS_OTDOA
hybridOTDOA_A-GNSS**	39	hybridAGNSS_OTDOA
hybridTDOA_A-GNSS*	39	hybridAGNSS_OTDOA
DBH	40	hybridDeviceBased

Location Object parameter (PIDF-LO: "Method token"*** Value)	Position Source parameter value	Position Source parameter value meaning
DBH_HELO	40	hybridDeviceBased
hybridRFPatternMatch_AGPS*	41	hybridAGPS_RFPatternMatch
hybridWiFi_AGPS*	42	hybridAGPS_Wi-Fi

* New Method Token values defined by NENA-STA-010.3, to be added to Internet Assigned Numbers Authority (IANA) Method Token Registry.

** New Method Token values defined by this standard, to be added to IANA Method Token Registry.

*** Methods Tokens assigned by the IANA can be found at: http://www.iana.org/assignments/method-tokens

- Callback Number - If the LSRG receives a Callback Number in the P-Asserted-Identity header of the INVITE message from an ESRP, or the NIF component generates a pseudo callback number for the call, the LIF component of the Legacy SR Gateway SHALL use this information to populate the Callback Number parameter in the esposreq message with an E.164 number that represents the emergency caller. Otherwise, this optional parameter SHALL be omitted from the esposreq message.
- Emergency Services Routing Key/Emergency Services Routing Digits (i.e., pANI) - The LIF component of the egress LSRG SHALL be able to receive the pANI created by the NIF component in the Emergency Services Routing Key parameter or the Emergency Services Routing Digits parameter of the ESPOSREQ message and SHALL use this pANI as the key to obtaining the emergency call related information to be populated in the response. The LIF component may return the pANI in the Emergency Services Routing Digits parameter of the esposreq message.
- Generalized Time - The LIF component of the LSRG SHALL populate the Generalized Time parameter with the date and time that the pANI was allocated to the current emergency call (with which it is associated and for which location information is being provided). The LIF component SHALL obtain this information from the NIF component.

- Company ID - The LIF component of the LSRG SHALL populate the CompanyID parameter in the esposreq message with the organizational name of the originating service provider, if available. Otherwise, this Optional parameter SHALL be omitted.
- Location Description - The LIF component of the LSRG SHALL populate the Location Description parameter in the esposreq message as described in NENA-STA-018.2-2021 [5], Section 9.3.16. The LIF component of the LSRG SHALL use the information obtained from the civic address location object (if present in a PIDF-LO associated with the call) to populate these fields using the mappings described in Table 3-14. The LIF component of the egress LSRG SHALL use the procedures described in Sections 3.2.2.6 and 3.3.3.3 to obtain non-location data to populate the <NAM> and <CPF> fields in the esposreq message.

Table 3-14. Mappings of Civic Address Data Elements to Tagged Fields in Location Description Parameter

Location Object parameter (PIDF-LO: Civic Address Type)	**Civic Address Component Description**	**NENA-STA-018.2-2021** [5] **tag in Location Description parameter**
PIDF-LO: CIVIC: COUNTRY	Country	Not mapped
PIDF-LO: Civic: HNO	House Number	Location Description: <HNO>
PIDF-LO: Civic: HNS	House Number Suffix	Location Description: <HNS>
PIDF-LO: Civic: PRD	Prefix Directional	Location Description: <PRD>
PIDF-: LO: CIVIC: PRM	Street Name Pre Modifier	Location Description: <STN>
PIDF-LO: Civic: RD	Street Name	Location Description: <STN>
PIDF-LO: Civic: STS	Street Name Suffix	Location Description: <STS>

Location Object parameter (PIDF-LO: Civic Address Type)	**Civic Address Component Description**	**NENA-STA-018.2-2021** [5] **tag in Location Description parameter**
PIDF-LO: Civic: POD	Street Name Post Directional	Location Description: <POD>
PIDF-LO: POM	Street Name Post Modifier	Location Description <STN>
PIDF-LO: Civic: A3	Incorporated Municipality[a]	Location Description: <MCN>
PIDF-LO: Civic: A4	Unincorporated Community[a]	Location Description: <MCN>
PIDF-LO: CIVIC: A5	Neighborhood Name	Not mapped
PIDF-LO: Civic: PCN	Postal Community Name[a]	Location Description: <MCN>
PIDF-LO: CIVIC: PC	Postal Code	Location Description: <ZIP>
PIDF-LO: Civic: A1	State	Location Description: <ST>
PIDF-LO: Civic: A2	County	Location Description: <COI>
PIDF-LO: CIVIC: MP	Milepost	Location Description: <LOC>
PIDF-LO: CIVIC: LMKP	Landmark Name Part	Location Description: <LOC>
PIDF-LO: CIVIC: LMK	Landmark Name	Location Description: <LOC>
PIDF-LO: Civic: LOC	Additional Location Information[c]	Location Description: <LOC>

Location Object parameter (PIDF-LO: Civic Address Type)	**Civic Address Component Description**	**NENA-STA-018.2-2021** [5] **tag in Location Description parameter**
PIDF-LO: Civic: BLD	Building[b]	Location Description: <LOC>
PIDF-LO: Civic: FLR	Floor[b]	Location Description: <LOC>
PIDF-LO: Civic: UNIT	Unit[b]	Location Description: <LOC>
PIDF-LO: Civic: ROOM	Room[b]	Location Description: <LOC>
PIDF-LO: Civic: SEAT	Seat[b]	Location Description: <LOC>
PIDF-LO: Civic: PLC	Place Type[b]	Location Description: <LOC>
PIDF-LO: <provided-by>	If the Provider Series in the Provider Info block is NENA, then this field is populated with the content of the Data Provider ID element	Location Description: <CPF>

a. These are mutually exclusive. Incorporated Municipality takes precedence over Unincorporated Community, which takes precedence over Postal Community.

b. Note that if this data element is included in the PIDF-LO, it is desirable that this information be included in the Location Description parameter, up to the maximum size of this field permitted by NENA-STA-018.2-2021 [5].

c. A part of a subaddress that is not a building, floor, unit, room, or seat.

3.3.3.3 De-Referencing Interfaces

If the location information received by the egress LSRG in the Geolocation header of an INVITE associated with an emergency call is in the form of a location reference, the egress LSRG MUST support SIP and HELD de-referencing protocols to support the de-referencing of the received location reference. The use of HELD as a dereferencing protocol is described in RFC 6753 [32]. SIP dereferencing requires support of the SIP Presence Event Package, as described in RFC 3856 [27]. The LIF component of the egress LSRG SHALL use the location reference received in the incoming INVITE message (and sent to it via the NIF component) to populate the HELD or SIP dereferencing request and to direct that request to the appropriate i3 functional element (i.e., LIS, Legacy Network Gateway, or ingress LSRG).

The LIF component of the egress LSRG MAY need to generate dereference requests to obtain Additional Data structures to populate the non-location fields in the E2/PAM response it sends to an ALI database. To do this, the LIF component SHALL support the HTTPS GET method described in RFC 7230 [25]to obtain the Additional Data "by-value". The egress LSRG SHALL use information contained in the Call-Info header of a received INVITE message to identify the address of the target ADR (or transfer-from PSAP, LPG or LSRG, in the case of a transferred call) to which the GET method will be directed. The LIF component MUST be capable of receiving and processing the data in the response from the ADR/primary PSAP/LPG/LSRG, and using it to populate the associated fields in the E2/PAM response to the ALI database in a manner that is appropriate for the target PSAP.

4 Operational Considerations

4.1 Roles and Responsibilities

The 9-1-1 Authority is responsible for providing the LSRG in the same way as it is responsible for providing the Selective Router and ALI system. As with the SR and ALI system, it may contract with a service provider to operate the LSRG on its behalf.

Existing SR/ALI operators, if they are not the same entity as the LSRG operator, must cooperate with the LSRG operator in provisioning, testing and providing ongoing service to assure that all 9-1-1 calls are answered by the proper PSAP and transfers of calls to other PSAPs (or other entities) work properly.

4.2 Operational Considerations for Legacy Selective Router Gateway Operators

An egress LSRG requires provisioning of E2/PAM connections to ALIs that steer queries to it based on the pANIs it assigns. Some ALI controllers have reached their maximum in terms of the number of connections they are capable of supporting, and the LSRG operator may need to make arrangements with another service provider to share their active connections.

An ingress LSRG requires the provisioning of ALI query interfaces. These may replace the ALI query connections from PSAPs that have migrated to the ESInet/NGCS.

Provisioning is also required to properly receive and place tandem-to-tandem calls. That implies the LSRG has a mapping between PSAP URIs in the ECRF and PSAP DNs that lead to the correct PSAP on the SR.

In addition, to support the routing of emergency calls by ingress LSRGs, the LSRG operator must work with the 9-1-1 Authority and the originating network provider to define the mappings that can be used by the LIF component of the ingress LSRG to identify the routing location for a 9-1-1 call. For example, for wireless 9-1-1 originations that are routed to an ingress LSRG by an SR that is serving an MSC, there must be a process that will allow the LSRG operator, originating network provider and 9-1-1 Authority to identify the associations between cell site sectors and PSAPs. That is, they must develop an agreement regarding to which PSAP calls from a given cell site sector will go. The 9-1-1 Authority then identifies the routing location that will be used to route calls from a given cell site sector toward the designated PSAP. The 9-1-1 Authority creates the mappings and provides them to the ingress LSRG operator who must provision the mappings into the LIF component.

4.3 Operational Considerations for PSAPs

With the exception of the role of the 9-1-1 Authority in specifying mappings of ESRKs/ESRDs/ESQKs to routing locations, as described in Section 4.2, the LSRG should be transparent to PSAP operations. PSAPs remaining on the SR may notice calls arrive with pANIs from wireline carriers who have transitioned to the ESInet/NGCS, and the pANI seen by the PSAP for a wireless or VoIP origination network may be different than the pANI originally assigned by the MPC/GMLC/VPC.

4.4 Operational Considerations for Origination Network Operators

With the exception of the role of the 9-1-1 Authority in specifying mappings of ESRKs/ESRDs/ESQKs to routing locations, as described in Section 4.2, the ingress LSRG should be transparent to origination networks. The caveats above about pANIs may affect how faults are diagnosed. The LSRG operator may have to be consulted to provide the mapping between pANIs sent with calls, and pANIs received by PSAPs.

5 Example Call Flows

5.1 Initial Call, Originating Network on ESInet, Primary PSAP on SR

5.1.1 Initial Call, Originating Network on ESInet, Primary PSAP on SR with Location-by-Value

This call flow illustrates a scenario where an emergency call is delivered to an i3 ESInet (either directly from an i3-compliant originating network or from a legacy originating network via a Legacy Network Gateway [LNG]) with location-by-value. Although typically the delivery of location-by-value is associated with an emergency origination from a fixed/wireline caller, this call flow allows for the location information to be in the form of either a civic or a geodetic location. The location value, along with an appropriate service URN, is used by the ESRP in the i3 ESInet to query the ECRF for routing information. The routing information provided by ECRF is associated with a legacy PSAP that is served by a legacy Selective Router. Based on the routing information provided by the ECRF, the ESRP routes the emergency call to an LSRG on the egress side of the i3 ESInet. The information signaled to the LSRG by the ESRP includes callback information, the location-by-value, and Additional Data (by-value or by-reference).

When the egress LSRG receives the emergency call, it determines the ESN associated with the call and allocates an ESN-appropriate pseudo callback number (if needed) and pANI. Depending on the capabilities of the outgoing trunk group, the LSRG signals the pANI and possibly the callback number, to the SR via the SS7 protocol. The SR delivers the call to the legacy PSAP via a Traditional or Enhanced MF interface (as appropriate based on per-PSAP provisioning), with the pANI and/or callback number. The PSAP queries the ALI with the pANI and/or callback number, and the ALI steers the query to the LSRG. This call flow example assumes that the E2 protocol is used between the ALI and the LSRG. The LSRG returns callback, location, and other information, to the ALI system via an E2 esposreq message.

This call flow example assumes that the PSAP initiates disconnect of the emergency call.

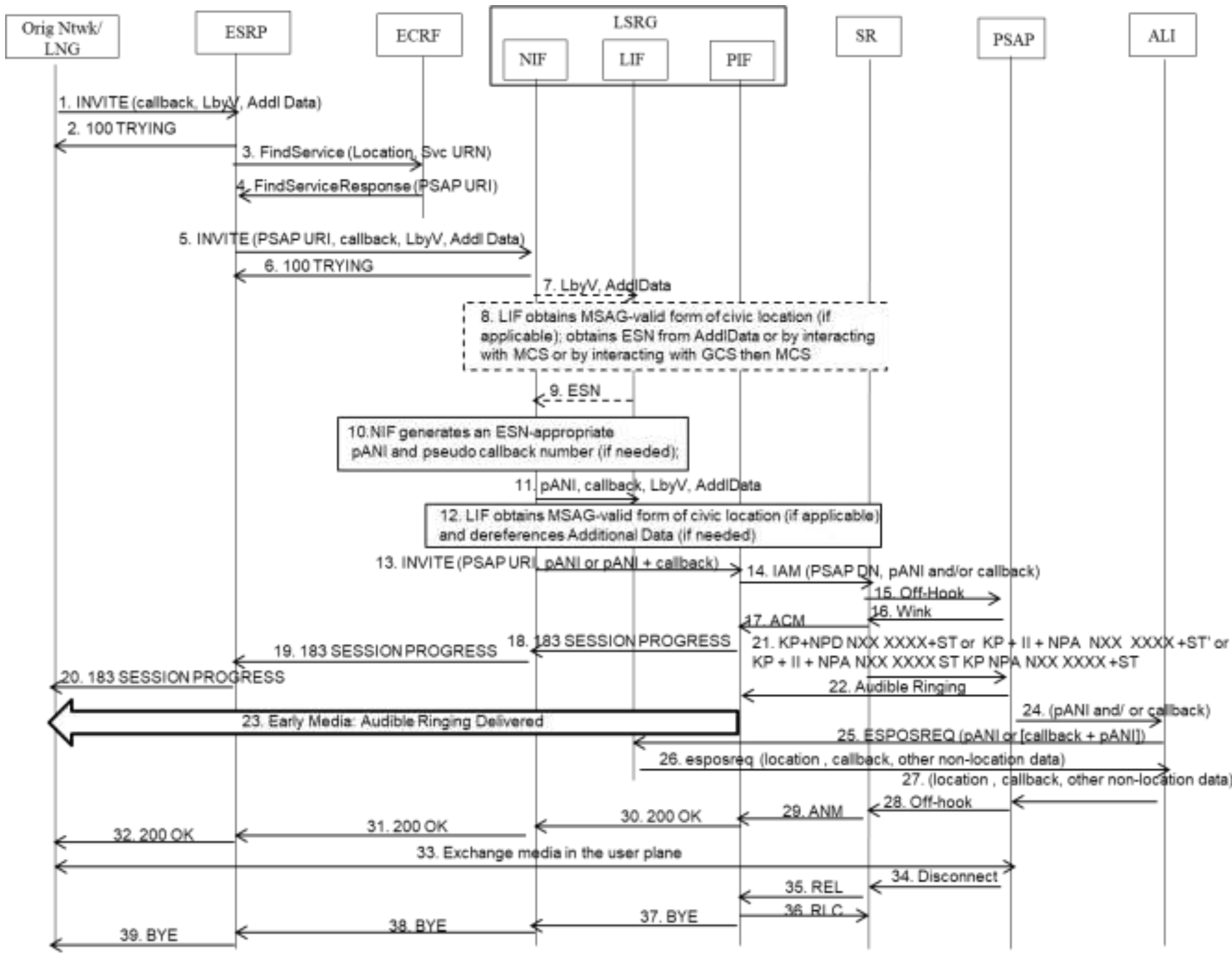


Figure 5-1: Initial Call, Originating Network on ESInet, Primary PSAP on SR with Location-by-Value

Step 1. The SIP INVITE message associated with the emergency call is delivered by the i3-compliant originating network or Legacy Network Gateway (depending on the type of origination) via a BCF to an ESRP in an i3 ESInet, with callback information, location-by-value, and Additional Data (either by-value or by-reference).

Step 2. The ESRP returns a 100 TRYING message.

Step 3. The ESRP queries the ECRF with the location information received in the body of the SIP INVITE message and an appropriate service URN to obtain routing information for the call.

Step 4. The ECRF returns a Route URI. In this example, the Route URI is associated with a legacy PSAP that is served by a Selective Router.

Step 5. The ESRP forwards the SIP INVITE message to an egress LSRG that is appropriate for the PSAP URI (i.e., an LSRG to which the PSAP URI obtained from the ECRF resolves). The SIP INVITE message contains the callback information, location-by-value, and Additional Data that the ESRP received in incoming signaling from the i3-compliant originating network/LNG.

Step 6. Upon receiving the incoming SIP INVITE message, the NIF component of the LSRG returns a 100 TRYING message to the ESRP.

Step 7. (Conditional) The NIF examines each Call-Info header field to see if one or more contains a 'purpose' value of "EmergencyCallData.LegacyESN", indicating the conveyance of an ESN Additional Data block.

If no ESN Additional Data blocks are present in the Additional Data received by the NIF component in the SIP INVITE message, the NIF will pass the location-by-value to the LIF component and proceed with Step 8.

If the Additional Data received by the NIF component in the SIP INVITE message includes one or more ESN Additional Data blocks "by reference" (the Call-Info header field URI has an "HTTPS" scheme), the NIF component will pass the location-by-value and all received ESN Additional Data blocks to the LIF component, and proceed with Step 8.

If all of the ESN Additional Data blocks received by the NIF component are "by value" (the Call-Info header field URI has a "CID" scheme), the NIF component will identify each ESN Additional Data block in the body of the message by matching body parts by Content-IDs to CID URIs. If the NIF finds more than one ESN Additional Data block, it may use the context (i.e., "locality") and provider information associated with the ESN Additional Data blocks to determine which ESN to use for the call. (The specific mechanism is left to implementation.) The NIF will then proceed with Step 10.

Step 8. (Conditional on Step 7) Upon receiving the location-by-value and ESN Additional Data block(s) (if present) from the NIF component, the LIF component will determine the ESN for the call in one of the following ways:

- If the LIF component receives one or more ESN Additional Data blocks from the NIF "by reference", the LIF component will initiate a de-reference request for each ESN Additional Data block that was received "by reference" to obtain the associated ESN (not shown). If the LIF component obtains more than one ESN (via dereferencing, possibly in combination with ESN Additional Data blocks passed "by value" from the NIF), the LIF may use the context (i.e., "locality") and provider information associated with the ESN Additional Data blocks to determine which ESN to use for the call. The specific mechanism is left to implementation.

- If no ESN Additional Data blocks are received from the NIF component, and the location-by-value consists of a civic location, the LIF component will query the MSAG Conversion Service (MCS) with the civic location. If the query is successful, the LIF component will receive the ESN and the MSAG-formatted version of the civic location in the response from the MCS.
- If no ESN Additional Data blocks are received from the NIF component, and the location-by-value consists of a geodetic location, the LIF component will interact with the GCS using the geodetic location to retrieve a civic address. The LIF component then interacts with the MSAG Conversion Service using the civic location to obtain the ESN for the call.

Step 9. (Conditional on Step 8) The LIF component will pass the ESN obtained in Step 8 to the NIF component.

Step 10. Having obtained the ESN (either directly from the Additional Data or from the LIF component), the NIF component generates an ESN-appropriate pANI for the call, following the procedures described in Section 3.2.2.1. Based on the PSAP URI received in the SIP INVITE message from the ESRP, the NIF component will identify the outgoing trunk group over which the call will be delivered to the interconnected legacy SR. If the trunk group supports delivery of both a callback number and a pANI, the NIF will examine the callback information received in the SIP INVITE from the ESRP.

If callback information is to be delivered to the SR and the callback information received in incoming signaling is in the form of (or easily converted to) a 10-digit NANP number, the callback information received in the SIP INVITE will be populated in the SS7 signaling sent to the SR.

If callback information is to be delivered to the SR and the callback information received in incoming signaling is not in the form of (or easily converted to) a 10-digit NANP number (i.e., the callback information consists of an international number or a URI that cannot be converted to a 10-digit NANP number), the NIF component of the LSRG will perform a mapping from the non-NANP callback information to a pseudo callback number formatted as described in Section 3.2.2.1.

Step 11. The NIF component passes the pANI, along with the callback information, location-by-value and Additional Data received in the SIP INVITE from the ESRP to the LIF component.

Step 12. (Conditional) If the location information received from the NIF component is in civic format, and the LIF has not already queried the MCS (i.e., because all of the ESN Additional Data blocks received by the NIF from the ESRP were "by value"), the LIF component will query the MCS with the civic location and receive the MSAG-formatted version of the civic location in the response from the MCS. The LIF will also de-reference any Additional Data blocks that were received "by reference" and were not previously de-referenced in Step 8.

Note that Steps 11 and 12 can be performed in parallel with Step 13 and subsequent call setup steps, as long as Steps 11 and 12 are performed before Step 26.

Step 13. The NIF component sends a SIP INVITE message to the PIF component that contains the PSAP URI, the pANI, and the callback number/pseudo callback number (if supported by the interface to the SR).

Step 14. The PIF component sends an SS7 Initial Address Message (IAM) to the legacy SR that contains an SS7 Called Party Number parameter populated with the PSAP number/address received in the Request URI of the incoming INVITE message from the NIF, and an SS7 Calling Party Number parameter populated with the pANI or callback number provided by the NIF in the P-Asserted-Identity header of the INVITE message sent to the PIF. If the PIF component receives a Geolocation header containing the pANI generated by the NIF component and a Geolocation-Routing header set to "no" in the INVITE message from the NIF component, the PIF component will populate the pANI in an SS7 Generic Digits Parameter.

Step 15. The legacy SR interacts with a Selective Routing Database (not shown) to obtain an ESN for the call which will be used if the PSAP initiates a Selective Transfer. The legacy SR also initiates call setup to the PSAP by sending an off-hook signal to the PSAP.

Step 16. The PSAP responds by providing a wink signal.

Step 17. Upon receiving the wink from the PSAP, the SR returns an SS7 Address Complete Message (ACM) with a Called Party Status indicator value set to "in-band information or an appropriate pattern is now available" to the PIF component of the LSRG.

Step 18. The PIF component generates a 183 SESSION PROGRESS message and sends it to the NIF component.

Step 19. The NIF component passes the 183 SESSION PROGRESS message to the ESRP.

Step 20. The ESRP passes the 183 SESSION PROGRESS message to the LNG or toward the UE served by the i3-compliant originating networks.

Step 21. The SR generates an MF signaling sequence that is appropriate for the type of interface supported by the PSAP.

- If the PSAP supports a Traditional MF interface, the SR will generate the MF sequence KP+NPD NXX XXXX+ST, where the 7 digits following the NPD digit will depend on what information was provided to the SR (i.e., pANI and/or callback number), and per-PSAP provisioning.
- If the PSAP supports an Enhanced MF interface with 10-digit delivery, the SR will generate the MF sequence KP + II + NPA NXX XXXX +ST', where the 10-digits following the II will depend on the what information was provided to the SR (i.e., pANI and/or callback number) and per-PSAP provisioning.
- If the PSAP supports an Enhanced MF interface with 20-digit delivery, the SR will generate the MF sequence KP + II + NPA NXX XXXX ST KP NPA NXX XXXX +ST, where the first 10-digit number following the II is the callback number and the second 10-digit number corresponds to the pANI.

Step 22. Upon receiving the MF signaling sequence from the SR, the PSAP alerts the call taker and returns audible ringing toward the caller.

Step 23. The PIF component passes audible ringing back toward the caller via the LNG or i3-compliant originating network.

Step 24. The PSAP uses the pANI and/or callback number received in incoming call setup signaling from the SR to query the ALI system.

Step 25. The ALI system steers the query to the LIF component of the LSRG. This call flow assumes that the E2 protocol is used between the ALI system and the LIF. The E2 ESPOSREQ message generated by the ALI system either contains the pANI or the callback number and the pANI, depending on the interface between the ALI system and the LIF.

Step 26. The LIF component populates the esposreq response using the callback number received in Step 11, the location information received in Step 7 or

Step 11 (if the location information is geodetic) or received in Step 8 or Step 12 (if the location is civic), and the other non-location information obtained in Step 11 (associated with ESN Additional Data blocks that were received "by value" or other Additional Data blocks that were received "by reference" or "by value") or in Step 8 (associated with ESN Additional Data blocks that were received "by reference").

Step 27. The ALI system returns the callback number, location information, and other non-location information to the PSAP.

Step 28. The PSAP generates an off-hook signal to the SR.

Step 29. The SR returns an SS7 Answer Message (ANM) to the PIF component.

Step 30. The PIF component passes a 200 OK message to the NIF component.

Step 31. The NIF component passes a 200 OK message to the ESRP.

Step 32. The ESRP passes a 200 OK message to the LNG/i3-compliant originating network.

Step 33. Media is exchanged between the caller and the PSAP in the user plane.

Note that Steps 24 through 27 can be performed in parallel with Steps 22 and 23, and Steps 28 through 33.

Step 34. The PSAP sends a disconnect signal to the SR.

Step 35. The SR sends an SS7 Release (REL) message to the PIF component.

Step 36. The PIF component responds be returning an SS7 Release Complete (RLC) message to the SR.

Step 37. The PIF returns a BYE message to the NIF component.

Step 38. The NIF component returns a BYE message to the ESRP.

Step 39. The ESRP returns a BYE message to the LNG/i3-compliant originating network.

5.1.2 Initial Call, Originating Network on ESInet, Primary PSAP on SR with Location-by-Reference

This call flow illustrates a scenario where an emergency call is delivered to an i3 ESInet (either directly from an i3-compliant originating network or from a legacy originating network via a Legacy Network Gateway [LNG]) with location-by-reference. Upon receiving the location-by-reference, the ESRP in the i3 ESInet must send a de-reference request to the LNG or LIS to obtain the routing location for the call. The ESRP will then use the routing location, along with an appropriate service URN, to query the ECRF for routing information. In this example call flow, the routing information provided by ECRF is associated with a legacy PSAP that is served by a legacy Selective Router. Based on the routing information provided by the ECRF, the ESRP routes the emergency call to an LSRG on the egress side of the i3 ESInet. The information signaled to the LSRG by the ESRP includes callback information, the location-by-reference, and Additional Data (by-value and/or by-reference).

When the egress LSRG receives the emergency call, it determines the ESN associated with the call and allocates an ESN-appropriate pseudo callback number (if needed) and pANI. Depending on the capabilities of the outgoing trunk group, the LSRG signals the pANI and possibly the callback number, to the SR via the SS7 protocol. The SR delivers the call to the legacy PSAP via a Traditional or Enhanced MF interface (as appropriate based on per-PSAP provisioning), with the pANI and/or callback number. The PSAP queries the ALI with the pANI and/or callback number, and the ALI steers the query to the LIF component of the LSRG. This call flow example assumes that the E2 protocol is used between the ALI and the LSRG. The LIF component sends a de-reference request to the LNG or LIS to obtain caller location for the emergency call. (If the call originated in a legacy wireless network, the LNG will interact with an MPC/GMLC in the originating network to obtain the caller location.) If the caller location is in the form of a civic location, the LIF must interact with the MSAG Conversion Service to obtain the MSAG-formatted form of the civic location. The LIF then returns callback, location, and other information, to the ALI system via an E2 esposreq message.

This call flow example assumes that the PSAP initiates disconnect of the emergency call.

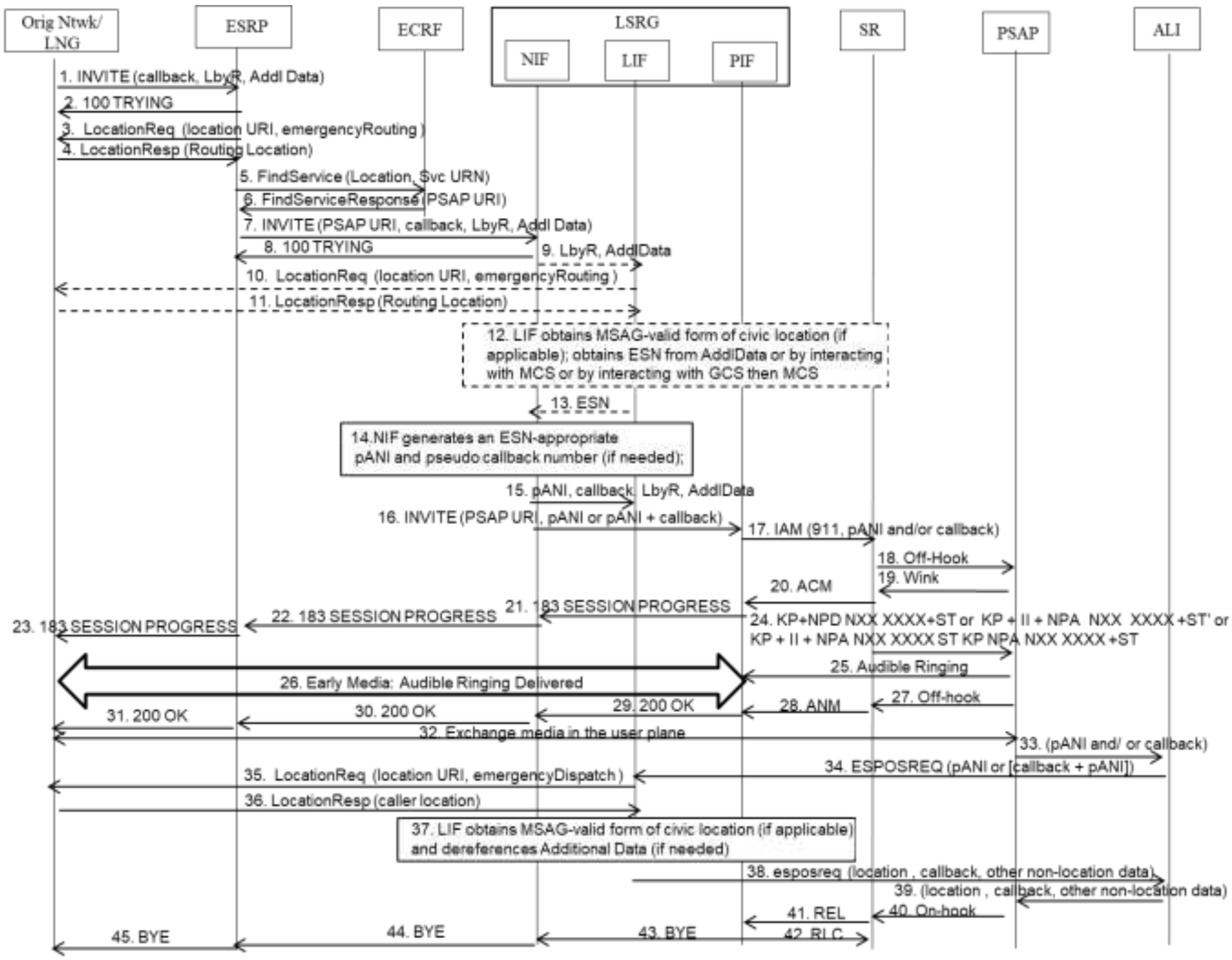


Figure 5-2: Initial Call, Originating Network on ESInet, Primary PSAP on SR with Location-by-Reference

Step 1. The SIP INVITE message associated with the emergency call is delivered by the i3-compliant originating network or Legacy Network Gateway (depending on the type of origination) via a BCF to an ESRP in an i3 ESInet, with callback information, location-by-reference, and Additional Data (by-value and/or by-reference).

Step 2. The ESRP returns a 100 TRYING message.

Step 3. The ESRP invokes a de-reference operation by sending a location request to the LNG or LIS (as appropriate for the type of origination) to obtain the routing location for the call.

Step 4. The LNG or LIS returns a location response that contains the routing location (by-value).

Step 5. The ESRP queries the ECRF, with the routing location obtained via the de-reference operation and an appropriate service URN, to obtain routing information for the call.

Step 6. The ECRF returns a Route URI. In this example, the Route URI is associated with a legacy PSAP that is served by a Selective Router.

Step 7. The ESRP forwards the SIP INVITE message to an egress LSRG that is appropriate for the PSAP URI (i.e., an LSRG to which the PSAP URI obtained from the ECRF resolves). The SIP INVITE message contains the callback information, location-by-reference, and Additional Data that the ESRP received in incoming signaling from the i3-compliant originating network or LNG.

Step 8. Upon receiving the incoming SIP INVITE message, the NIF component of the LSRG returns a 100 TRYING message to the ESRP.

Step 9. (Conditional) The NIF examines each Call-Info header field to see if one or more contains a 'purpose' value of "EmergencyCallData.LegacyESN", indicating the conveyance of an ESN Additional Data block.

If no ESN Additional Data blocks are present in the Additional Data received by the NIF component in the SIP INVITE message, the NIF will pass the location-by-reference to the LIF component and proceed with Step 10.

If the Additional Data received by the NIF component in the SIP INVITE message includes one or more ESN Additional Data blocks "by reference", the NIF component will pass the location-by-reference and all ESN Additional Data blocks to the LIF component, and proceed with Step 10.

If all of the ESN Additional Data blocks received by the NIF component are "by value", the NIF component will identify each ESN Additional Data block in the body of the message by matching body parts by Content-IDs to CID URIs. If the NIF finds more than one ESN Additional Data block, it may use the context (i.e., "locality") and provider information associated with the ESN Additional Data blocks to determine which ESN to use for the call. (The specific mechanism is left to implementation.) The NIF will then proceed with Step 14.

Step 10. (Conditional on Step 9) Upon receiving the location-by-reference and ESN Additional Data block(s) (if present) from the NIF component, the LIF component will determine the ESN for the call in one of the following ways:

- If the LIF component receives one or more ESN Additional Data blocks from the NIF "by reference", the LIF component will initiate a de-reference request for each ESN Additional Data block that was received "by reference" to obtain the associated ESN (not shown). If the LIF component obtains more than one ESN (via dereferencing, possibly in combination with ESN Additional Data blocks passed "by value" from the NIF), the LIF may use the context (i.e., "locality") and provider information associated with the ESN Additional Data block to determine which ESN to use for the call. The specific mechanism is left to implementation.
- If no ESN Additional Data blocks are received from the NIF component, the LIF will send a location de-reference request to the LNG or LIS (as appropriate for the type of origination) to obtain the caller location.

Step 11. (Conditional on Step 10) The LNG or LIS (as appropriate for the type of origination) will return a caller location to the LIF component in the location de-reference response.

Step 12. (Conditional on Step 11) The LIF processes the caller location returned in the location de-reference response as follows:

- If the caller location returned in the location de-reference response consists of a civic location, the LIF component will query the MCS with the civic location. If the query is successful, the LIF component will receive the ESN and the MSAG-formatted version of the civic location in the response from the MCS.
- If the caller location returned in the location de-reference response consists of a geodetic location, the LIF component will interact with the GCS using the geodetic location to retrieve a civic address. The LIF component then interacts with the MSAG Conversion Service using the civic location to obtain the ESN for the call.

Step 13. (Conditional on Steps 10 through 12) The LIF component passes the ESN obtained via Steps 10 through 12 to the NIF component.

Step 14. Having obtained the ESN (either directly from the Additional Data or from the LIF component), the NIF component generates an ESN-appropriate pANI for the call, following the procedures described in Section 3.2.2.1. Based on the PSAP URI received in the SIP INVITE message from the ESRP, the NIF component will identify the outgoing trunk group over which the call will be delivered to the interconnected legacy SR. If the trunk group supports delivery of both a callback number and a pANI, the NIF will examine the callback information received in the SIP INVITE from the ESRP.

If callback information is to be delivered to the SR and the callback information received in incoming signaling is in the form of (or easily converted to) a 10-digit NANP number, the callback information received in the SIP INVITE will be populated in the SS7 signaling sent to the SR.

If callback information is to be delivered to the SR and the callback information received in incoming signaling is not in the form of (or easily converted to) a 10-digit NANP number (i.e., the callback information consists of an international number or a URI that cannot be converted to a 10-digit NANP number), the NIF component of the LSRG will perform a mapping from the non-NANP callback information to a pseudo callback number formatted as described in Section 3.2.2.1.

Step 15. The NIF component passes the pANI, along with the callback information (or pseudo callback number, if one was created), location-by-reference and Additional Data received in the SIP INVITE from the ESRP to the LIF component.

Step 16. The NIF component sends a SIP INVITE message to the PIF component that contains the PSAP URI, the pANI, and the callback number/pseudo callback number (if supported by the interface to the SR).

Step 17. The PIF component sends an SS7 Initial Address Message (IAM) to the legacy SR that contains an SS7 Called Party Number parameter populated with the PSAP number/address received in the Request URI of the incoming INVITE message from the NIF, and an SS7 Calling Party Number parameter populated with the pANI or callback number provided by the NIF in the P-Asserted-Identity header of the INVITE message sent to the PIF. If the PIF component receives a Geolocation header containing the pANI generated by the NIF component and a Geolocation-Routing header set to "no" in the INVITE message from the NIF component, the PIF component will populate the pANI in an SS7 Generic Digits Parameter.

Step 18. The legacy SR interacts with a Selective Routing Database (not shown) to obtain an ESN for the call which will be used if the PSAP initiates a Selective Transfer. The legacy SR also initiates call setup to the PSAP by sending an off-hook signal to the PSAP.

Step 19. The PSAP responds by providing a wink signal.

Step 20. Upon receiving the wink from the PSAP, the SR returns an SS7 Address Complete Message (ACM) with a Called Party Status indicator value set to "in-band information or an appropriate pattern is now available" to the PIF component of the LSRG.

Step 21. The PIF component generates a 183 SESSION PROGRESS message and sends it to the NIF component.

Step 22. The NIF component passes the 183 SESSION PROGRESS message to the ESRP.

Step 23. The ESRP passes the 183 SESSION PROGRESS message to the LNG or toward the UE served by the i3-compliant originating network.

Step 24. The SR generates an MF signaling sequence that is appropriate for the type of interface supported by the PSAP.

- If the PSAP supports a Traditional MF interface, the SR will generate the MF sequence KP+NPD NXX XXXX+ST, where the 7 digits following the NPD digit will depend on what information was provided to the SR (i.e., pANI and/or callback number), and per-PSAP provisioning.
- If the PSAP supports an Enhanced MF interface with 10-digit delivery, the SR will generate the MF sequence KP+II+NPA NXX XXXX+ST', where the 10 digits following the II will depend on the what information was provided to the SR (i.e., pANI and/or callback number) and per-PSAP provisioning.
- If the PSAP supports an Enhanced MF interface with 20-digit delivery, the SR will generate the MF sequence KP+II+NPA NXX XXXX ST KP NPA NXX XXXX+ST, where the first 10-digit number following the II is the callback number and the second 10-digit number corresponds to the pANI.

Step 25. Upon receiving the MF signaling sequence from the SR, the PSAP alerts the call taker and returns audible ringing toward the caller.

Step 26. The PIF component passes audible ringing back toward the caller via the LNG or i3-compliant originating network.

Step 27. The PSAP generates an off-hook signal to the SR.

Step 28. The SR returns an SS7 Answer Message (ANM) to the PIF component.

Step 29. The PIF component passes a 200 OK message to the NIF component.

Step 30. The NIF component passes a 200 OK message to the ESRP.

Step 31. The ESRP passes a 200 OK message to the LNG/i3-compliant originating network.

Step 32. Media is exchanged between the caller and the PSAP in the user plane.

Step 33. The PSAP uses the pANI and/or callback number received in incoming call setup signaling from the SR to query the ALI system.

Step 34. The ALI system steers the query to the LIF component of the LSRG. This call flow assumes that the E2 protocol is used between the ALI system and the LIF. The E2 ESPOSREQ message generated by the ALI system either contains the pANI or the callback number and the pANI, depending on the interface between the ALI system and the LIF.

Step 35. Upon receiving the query from the ALI system, the LIF will send a location de-reference request to the LNG or LIS (as appropriate for the type of origination) to obtain the caller location.

Step 36. The LNG or LIS returns the caller location in the location de-reference response.

Step 37. (Conditional) If the location information obtained via the location de-reference operation is in civic format, and the LIF has not already queried the MCS with the same civic location, the LIF component will query the MCS with the civic location and receive the MSAG-formatted version of the civic location in the response from the MCS. The LIF will also de-reference the Additional Data (not shown), if the Additional Data was received "by reference" and it was not previously de-referenced in Step 10.

Step 38. The LIF component will populate the esposreq response using the callback number or pseudo callback number (if one was created) received in Step 15, the location information received in Step 36, and the other non-location information obtained in Step 15 (associated with Additional Data blocks that were received "by value") or in Step 10 or Step 37 (associated with Additional Data blocks that were received "by reference").

Step 39. The ALI system returns the callback number/pseudo callback number, location information, and other non-location information to the PSAP.

Step 40. The PSAP sends an on-hook signal to the SR.

Step 41. The SR sends an SS7 Release (REL) message to the PIF component.

Step 42. The PIF component responds be returning an SS7 Release Complete (RLC) message to the SR.

Step 43. The PIF returns a BYE message to the NIF component.

Step 44. The NIF component returns a BYE message to the ESRP.

Step 45. The ESRP returns a BYE message to the LNG/i3-compliant originating network.

5.2 Initial Call, Originating Network on SR, Primary PSAP on ESInet

5.2.1 Initial Call, Originating Network on SR, Primary i3 PSAP on ESInet with Location-by-Value

This call flow illustrates a scenario where an emergency call originates at a legacy switch that is served by a Selective Router and is routed via an ingress LSRG to an i3 ESInet with location-by-value. Since the delivery of location-by-value is typically associated with an emergency origination from a fixed/wireline caller, this call flow example assumes that the location information is in civic format. The location value, along with an appropriate service URN, is used by the ingress LSRG to query an external ECRF to obtain routing information for the call. The response from the ECRF includes a URI associated with an ESRP on the i3 ESInet. The LSRG forwards the call and includes callback information, the location-by-value, and Additional Data (by-value and/or by-reference) in outgoing signaling. Upon receiving the emergency call, the ESRP queries an internal ECRF using the received location information and an appropriate service URN to determine next hop routing. The routing information provided by the internal ECRF is associated with an i3 PSAP. The ESRP then routes the emergency call to the i3 PSAP. The information signaled to the i3 PSAP includes callback information, the location-by-value, and Additional Data (by-value and/or by-reference).

This call flow example assumes that the PSAP initiates disconnect of the emergency call.

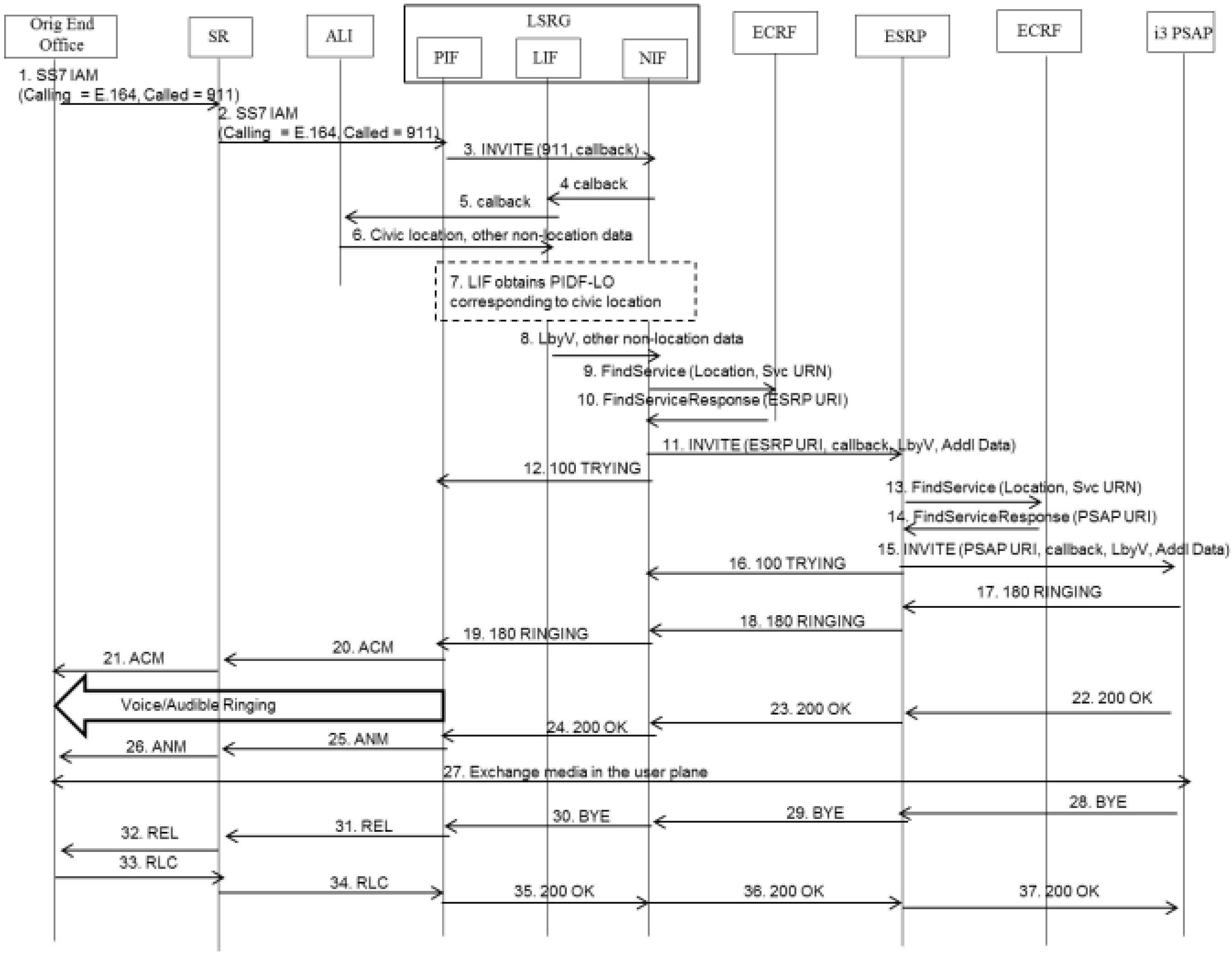


Figure 5-3: Initial Call, Originating Network on SR, i3 PSAP on ESInet with Location-by-Value

Step 1. In this example, it is assumed that the end office delivers the call over an SS7 trunk group to the SR. The SS7 IAM sent by the end office to the SR includes an E.164 number signaled in the SS7 Calling Party Number parameter, and the digits "9-1-1" in the Called Party Number parameter.

Step 2. The SR queries an SRDB (not shown) and receives an ESN that points to an outgoing tandem-to-tandem trunk group that interconnects the SR with the ingress LSRG. The SR signals an SS7 IAM to the PIF component of the LSRG, containing parameters populated as described in GR-2956-CORE [51], Section 5.2.2.1, R2956-84, with the following clarification: the address signals in the Called Party Number parameter are coded with the digits "9-1-1". The IAM also contains the Calling Party Number parameter populated as received from the originating end office.

Step 3. Upon receiving the incoming emergency call from a legacy SR, the PIF will generate a SIP INVITE message and pass it to the NIF component of the LSRG. The SIP INVITE will contain the digits "9-1-1" (expressed as a URI) in the To and Request-URI headers, and the information contained in the SS7 Calling Party Number parameter (expressed as a URI) as callback information in the From and P-Asserted-Identity headers.

Step 4. The NIF component passes the callback information received in the P-Asserted-Identity header to the LIF component of the LSRG.

Step 5. The LIF component uses the callback information to query the ALI system.

Step 6. In this call flow example, the ALI returns a civic location associated with the emergency caller, along with other non-location information provisioned in the ALI, to the LIF.

Step 7. The LIF interacts with the MSAG Conversion Service (MCS) (not shown) to acquire the PIDF-LO associated with the MSAG-valid civic address provide by the ALI.

Step 8. The LIF passes the location-by-value, along with an indication that the "Service Delivered by Provider to End User" is "POTS" to the NIF component. In addition, the LIF passes non-location information obtained from the ALI system (e.g., class of service, NENA Company ID, ESN) to the NIF component.

Step 9. The NIF component uses the location-by-value, and an emergency service URN, to query an external ECRF for routing information.

Step 10. The ECRF returns a URI associated with an ESRP in an i3 ESInet.

Step 11. The NIF component creates an Additional Data structure, and passes the Additional Data (by value and/or by reference), along with the location-by-value to the ESRP in an outgoing SIP INVITE message. If the NIF receives ESN information from the LIF component, the Additional Data created by the NIF component SHALL include an ESN Additional Data block. The SIP INVITE message will also include the digits "9-1-1" (expressed as a URI) in the To header, a service URN in the "sos" family in the Request-URI (not shown), and From and P-Asserted-Identity headers populated with the calling number received in the From and P-Asserted-Identity headers provided in the SIP INVITE from the PIF component, along with a Route header that contains the ESRP URI.

Step 12. The NIF component also returns a 100 TRYING message to the PIF component.

Step 13. Upon receiving the SIP INVITE message from the NIF component, the ESRP queries an internal ECRF with the location-by-value received in the incoming SIP INVITE message and an appropriate service URN.

Step 14. In this call flow example, the ECRF responds with a URI associated with an i3 PSAP.

Step 15. The ESRP sends a SIP INVITE message to the i3 PSAP that includes Additional Data (by value and/or by reference), location-by-value, the digits "9-1-1" (expressed as a URI) in the To header, a service URN in the "sos" family in the Request-URI (not shown), callback information in the From and P-Asserted-Identity headers, and a Route header that contains the PSAP URI.

Step 16. The ESRP returns a 100 TRYING message to the NIF component of the LSRG.

Step 17. The i3 PSAP returns a 180 RINGING message to the ESRP indicating that the PSAP is being alerted to the incoming emergency call.

Step 18. The ESRP passes the 180 RINGING message to the NIF component of the LSRG.

Step 19. The NIF component passes the 180 RINGING message to the PIF component of the LSRG.

Step 20. The PIF component maps the incoming 180 RINGING message to an SS7 ACM and sends it to the SR.

Step 21. The SR passes the ACM to the originating end office.

Audible ringing is provided by the PIF component of the ingress LSRG back to the caller.

Step 22. When the i3 PSAP answers the call, it returns a 200 OK message to the ESRP.

Step 23. The ESRP passes the 200 OK message to the NIF component of the ingress LSRG.

Step 24. The NIF component passes the 200 OK message to the PIF component.

Step 25. The PIF component maps the 200 OK message into an SS7 ANM, and returns the ANM to the SR.

Step 26. The SR returns the ANM to the originating end office.

Step 27. Media is exchanged between the caller and the i3 PSAP in the user plane.

Step 28. The i3 PSAP sends a SIP BYE message to the ESRP indicating its desire to disconnect from the call.

Step 29. The ESRP returns a SIP BYE message to the NIF component of the LSRG.

Step 30. The NIF component sends a SIP BYE message to the PIF component of the LSRG.

Step 31. The PIF component maps the SIP BYE message to an SS7 Release (REL) message and sends it to the SR.

Step 32. The SR sends an SS7 Release (REL) message to the originating end office.

Step 33. The originating end office responds by returning an SS7 Release Complete (RLC) message to the SR.

Step 34. The SR responds be returning an SS7 Release Complete (RLC) message to the PIF component.

Step 35. The PIF component of the ingress LSRG returns a 200 OK message to the NIF component.

Step 36. The NIF component of the ingress LSRG sends a 200 OK message to the ESRP.

Step 37. The ESRP sends a 200 OK message to the i3 PSAP.

5.3 Transferred Call, From Legacy PSAP on SR to i3 PSAP

This call flow illustrates a scenario where an emergency call that is routed via an egress LSRG to a legacy PSAP that is served by a Selective Router is subsequently transferred by that legacy PSAP to an i3 PSAP. The legacy PSAP initiates the transfer by sending a flash signal to the SR. When the SR receives the flash signal, it returns dial tone to the legacy PSAP and prepares to receive DTMF signaling. The legacy PSAP then signals a "*XX code", a string consisting of "# + 4-digits", or the 7/10 digit directory number associated with the transfer-to PSAP/public safety agency. The SR identifies the transfer-to party based on the incoming signaling received from the PSAP and/or provisioning. The SR then invokes bridging functionality and initiates the transfer leg of the call by sending an SS7 IAM to the LSRG. The IAM identifies the transfer-to PSAP in the Called Party Number parameter and the callback number or pANI (as received in the Calling Party Number parameter of the IAM associated with the original emergency call) in the Calling Party Number parameter. If the SR received a Generic Digits Parameter in the IAM associated with the original emergency call, it will include a Generic Digits Parameter in the IAM associated with the transferred call. The IAM associated with the transferred leg of the call will also include a Calling Party's Category parameter set to "emergency call", and an Originating Line Information parameter, if received in the IAM associated with the original emergency call. Upon receiving the IAM from the SR, the PIF component of the LSRG generates a SIP INVITE message that includes: a Request-URI and To header that contains the 10-digit number/address associated with the transfer-to PSAP, formatted as a URI; a From header that either contains the information contained in the SS7 Calling Party Number parameter, if no Generic Digits Parameter is present, or the information contained in the Generic Digits Parameter, if present; a P-Asserted-Identity header that contains the information from the SS7 Calling Party Number parameter, along with a cpc parameter and an oli parameter (if received in the SS7 IAM). If an SS7 Charge Number was received in the IAM, the SIP INVITE will also include a P-Charge-Info header. The PIF component passes the SIP INVITE to the NIF component.

The NIF component then sends a SIP INVITE to the ESRP. The INVITE includes: a Route header and a To header that contain the10-digit number/address associated with the target PSAP (expressed as a URI); a Request-URI that contains a service URN (e.g., urn:emergency:service:sos.police); a From header that contains the callback number associated with the pANI received by the NIF component in incoming signaling from the PIF component (see Section 3.2.1.3.3 for further details); a P-Asserted-Identity header that contains the callback number associated with the pANI received in incoming signaling from the PIF component, but that does not contain cpc or oli parameters (see Section 3.2.1.3.3 for further details); a P-Charge-Info header if received from the PIF component; a History-Info header with a Reason parameter that includes an indication of why and how the call arrived at the LSRG (i.e., because the call has undergone diversion); and a Call-Info header that contains a URI which can be used to access an EIDO.

The ESRP passes the SIP INVITE to the transfer-to i3 PSAP. The transfer-to i3 PSAP returns a 180 RINGING message to the ESRP, which passes it to the LSRG. The LSRG maps the 180 RINGING message to an SS7 ACM and passes it to the SR. The LSRG also applies audible ringing toward the transfer-from legacy PSAP.

The transfer-to i3 PSAP dereferences the EIDO. Upon answering the transferred call, the transfer-to i3 PSAP returns a 200 OK message to the ESRP, which passes it to the LSRG. The LSRG interworks the 200 OK message to an SS7 ANM message and passes it to the SR. The SR then sends an off-hook signal to the transfer-from legacy PSAP. At this point the caller, the transfer-from legacy PSAP and the transfer-to i3 PSAP are all conferenced together and can communicate with each other. The transfer-from PSAP then completes the transfer by sending an on-hook signal to the SR. The caller and the transfer-to i3 PSAP remain conferenced together at the SR.

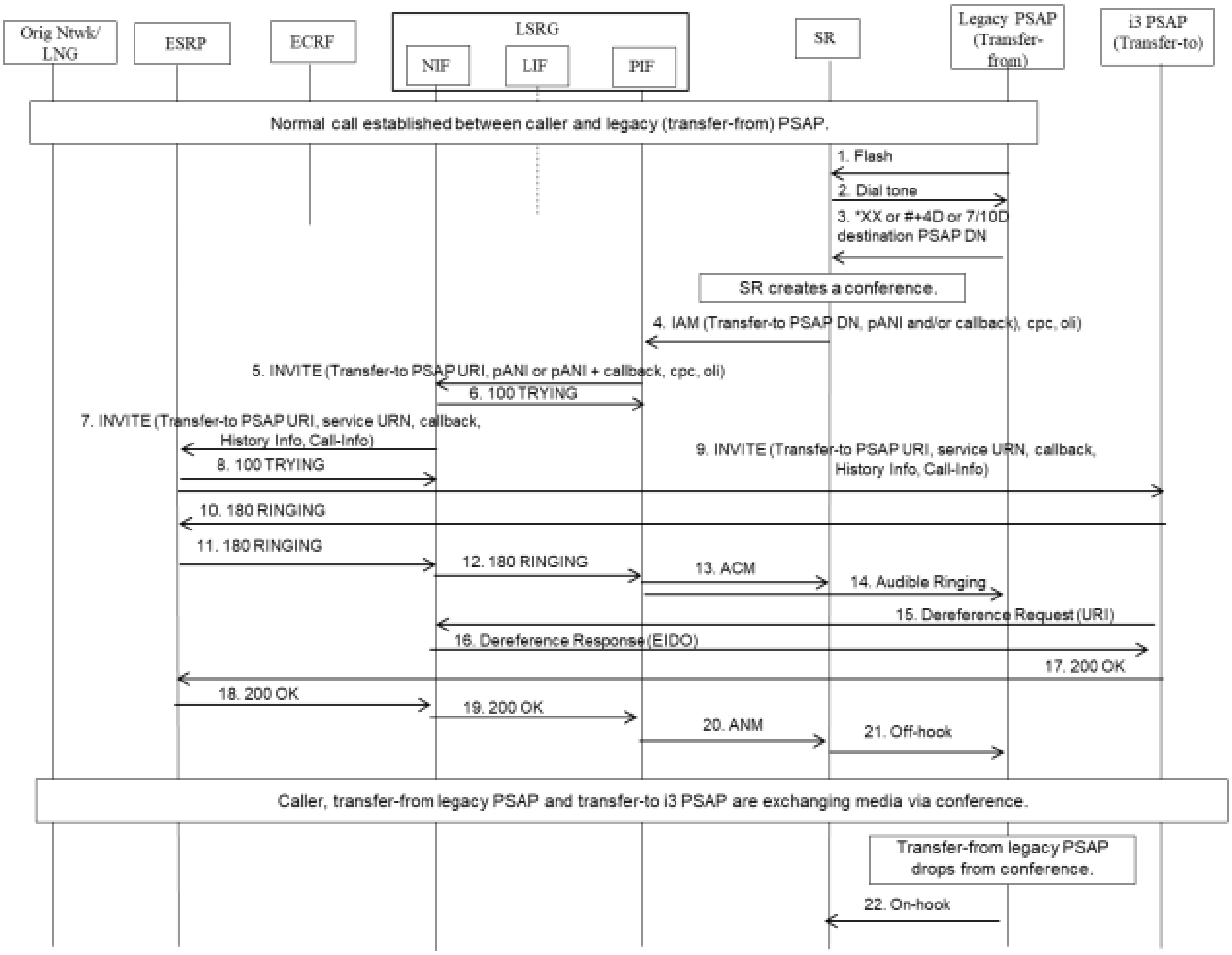


Figure 5-4: Transferred Call, From Legacy PSAP on SR to i3 PSAP

In this example, it is assumed that an emergency call has been established, via an LSRG, between a caller and a legacy PSAP that is served by an SR.

Step 1. Upon determining that an emergency call needs to be transferred, the legacy PSAP initiates a transfer request by sending a flash signal to the SR.

Step 2. When the SR receives the flash signal, it returns dial tone to the legacy PSAP and prepares to receive DTMF signaling.

Step 3. The legacy PSAP provides a "*XX code", a string consisting of "# + 4-digits", or the 7/10 digit directory number associated with the transfer-to PSAP/Public Safety agency.

Step 4. The SR creates a conference and sends an SS7 IAM to the PIF component of the LSRG. The IAM includes: a Called Party Number parameter that identifies the transfer-to PSAP; a Calling Party Number parameter that contains the information received in the Calling Party Number parameter of the IAM associated with the original emergency call (i.e., the callback number or pANI); a Generic Digits Parameter if received in the IAM associated with the original emergency call; a Calling Party's Category parameter set to "emergency call", and a Charge Number parameter and Originating Line Information parameter, if received in the IAM associated with the original emergency call

Step 5. The PIF component of the LSRG interworks the SS7 IAM to a SIP INVITE message and passes the INVITE to the NIF component. The SIP INVITE includes: a Request-URI and To header that contains the 10-digit number/address associated with the transfer-to PSAP, formatted as a URI; a From header that either contains the information contained in the SS7 Calling Party Number parameter, if no Generic Digits Parameter is present, or the information contained in the Generic Digits Parameter, if present; a P-Asserted-Identity header that contains the information from the SS7 Calling Party Number parameter, along with a cpc parameter and an oli parameter (if received in the SS7 IAM); and a P-Charge Info header if an SS7 Charge Number was received in the IAM.

Step 6. The NIF returns a 100 TRYING message to the PIF component.

Step 7. The NIF component generates a SIP INVITE and sends it to the ESRP. The INVITE includes: a Route header and a To header that contain the10-digit number/address associated with the target PSAP (expressed as a URI); a Request-URI that contains a service URN; a From header that contains the callback number associated with the pANI received from the PIF component; a P-Asserted-Identity header that contains the callback number associated with the pANI received in incoming signaling from the PIF component (and no cpc or oli parameters); a P-Charge-Info header if received from the PIF component; a History-Info header with an appropriate Reason parameter; and a Call-Info header that contains a URI which can be used to access an EIDO.

Step 8. The ESRP returns a 100 TRYING message to the NIF component of the LSRG.

Step 9. The ESRP passes the SIP INVITE message to the transfer-to i3 PSAP.

Step 10. The i3 PSAP returns a 180 RINGING message to the ESRP.

Step 11. The ESRP returns a 180 RINGING message to the NIF component of the LSRG.

Step 12. The NIF component of the LSRG returns a 180 RINGING message to the PIF component of the LSRG.

Step 13. The PIF component interworks the 180 RINGING message to an SS7 ACM and sends the ACM to the SR.

Step 14. The PIF component of the LSRG also applies audible ringing toward the transfer-from legacy PSAP.

Step 15. The transfer-to i3 PSAP sends an EIDO dereference request to the LSRG. Note this can happen any time after the transfer-to i3 PSAP receives the SIP INVITE in Step 9.

Step 16. The LSRG returns the EIDO it created (see Section 2.1.3) to the transfer-to i3 PSAP in response to the dereference request.

Step 17. When the transfer-to i3 PSAP answers the call, it returns a 200 OK message to the ESRP.

Step 18. The ESRP passes the 200 OK message to the NIF component of the ingress LSRG.

Step 19. The NIF component passes the 200 OK message to the PIF component.

Step 20. The PIF component maps the 200 OK message into an SS7 ANM, and returns the ANM to the SR.

Step 21. The SR sends an off-hook signal to the transfer-from legacy PSAP.

The caller, transfer-from legacy PSAP and transfer-to i3 PSAP are all participants in the conference and can exchange media.

Step 22. When the transfer-from legacy PSAP determines that it should drop off the conference and complete the transfer, it sends an on-hook signal to the SR.

The caller and the transfer-to i3 PSAP remain in the conference that is being maintained by the SR.

5.4 Transferred Call, From i3 PSAP to Legacy PSAP on SR

This call flow illustrates a scenario where an emergency call that is delivered to an i3 PSAP is subsequently transferred via an egress LSRG to a legacy PSAP that is served by a

Selective Router. This call flow assumes that the transfer initiated by the i3 PSAP is an attended transfer, and that the Ad Hoc transfer procedures described in Section 4.7.1 of NENA-STA-010.3 [43] have been implemented by the ESInet/NGCS that is serving the i3 PSAP. Following the procedures in Section 4.7.1 of NENA-STA-010.3, the i3 PSAP initiates the transfer by establishing a conference with the conference bridge, then requests that the conference bridge invite the caller/B2BUA to the conference by sending a REFER method to the conference bridge that contains an escaped Replaces header field value in the URI included in the Refer-To header field. The bridge invites the caller/B2BUA to the conference by sending an INVITE method containing the Conf-ID and a Replaces header field that references the leg between the caller/B2BUA and the transfer-from PSAP.

As illustrated in Figure 5-5, once the caller has joined the conference, the i3 PSAP sends a REFER method to the conference bridge requesting that it invite the legacy transfer-to PSAP to the conference. The REFER method includes the Conf-ID and a Refer-To header field that contains the URI of the transfer-to PSAP. Since, in this example, the transfer-to PSAP is a legacy PSAP that is served by an SR, the Refer-To header will contain the 10-digit number/address associated with the transfer-to PSAP, expressed as a URI (e.g., sos:psap@lsrg or sip:telno@lsrg user=phone). The REFER method also contains an escaped Call-Info header field value containing a reference URI that points to the EIDO data structure and a purpose parameter of "eido". The bridge then sends an INVITE message toward the LSRG that is interconnected with the SR that is serving the transfer-to PSAP. The INVITE message includes: the URI associated with the conference bridge; the transfer-to PSAP URI; an appropriate service URN for the transfer scenario; a Contact header that contains the Conf-Id and an "isfocus" parameter; a History-Info header with a Reason parameter that indicates that the call has undergone diversion; and a Call-Info header that contains a URI which, when de-referenced, can be used to access an EIDO.

Upon receiving the INVITE message, the NIF component of the LSRG identifies the outgoing trunk group to the interconnected SR based on the transfer-to PSAP number/address received in the INVITE message from the conference bridge, and determines the content and format of the information that should be delivered to it. The NIF component also passes the Call-Info header containing the EIDO URI to the LIF component. The LIF component sends a dereference request to the transfer-from i3 PSAP to obtain the EIDO. Based on the information received in the EIDO, the LIF will identify the callback information, location information, and the ESN that is to be used in processing the transferred call. The LIF passes the ESN, location information and callback information to the NIF component. The NIF component generates an ESN-appropriate pANI (which it associates with the location information) and a pseudo-callback number (if needed) for the call. The NIF component then generates an INVITE message and sends it to the PIF component. The INVITE message will include the 10-digit number/address associated with the transfer-to PSAP, expressed as a URI, a pANI or pANI + callback number, depending on the provisioning associated with the outgoing trunk group to the SR, and the conference URI. The NIF component also passes the pANI and the associated callback and location information to the LIF component to support location and callback number delivery to the legacy PSAP.

Upon receiving the INVITE message from the NIF component, the PIF component will generate an SS7 IAM and send it to the SR. The content of the IAM will depend on the information received from the NIF component in the INVITE message. The IAM will contain a 10-digit PSAP number/address associated with the transfer-to legacy PSAP in the Called Party Number parameter, either the callback number or the pANI created by the LSRG (depending on what was received in the P-Asserted-Identity header of the INVITE message from the NIF component) in an SS7 Calling Party Number parameter. If the NIF component receives a Geolocation header containing URI that can be easily converted to a 10-digit Number, and a Geolocation-Routing header set to "no", the PIF component will include a Generic Digits Parameter in the outgoing IAM that contains the digits in the userinfo portion of the URI signaled in the Geolocation header and the SS7 Calling Party Number parameter will contain the callback number.

The SR queries the Selective Routing Database (SRDB) with the callback number or pANI (based on provisioning at the SR) to obtain an ESN that can be used to support Selective Transfer, should the legacy PSAP determine that a subsequent Selective Transfer is necessary. The SR identifies the transfer-to party and routes the call based on the PSAP number populated in the SS7 Called Party Number parameter of the received IAM. The SR generates an MF off-hook signal toward the legacy PSAP, and upon receiving a wink signal in response, generates an SS7 ACM toward the PIF component of the LSRG. The PIF component then returns a 183 SESSION PROGRESS message to the NIF component. The NIF passes the 183 SESSION PROGRESS message back to the bridge. The SR generates the appropriate Traditional MF or Enhanced MF signaling sequence to deliver the transferred call to the legacy PSAP. The legacy PSAP generates audible ringing back through the SR to the LSRG. The legacy PSAP also queries the ALI for location information using the callback number and/or pANI received from the SR. The ALI steers the query back to the LIF component of the LSRG. The LIF responds to the query from the ALI, returning location and non-location (e.g., callback) information to the ALI. The ALI passes the information to the legacy PSAP.

In parallel with the ALI query, the legacy PSAP answers the call, sending an off-hook signal to the SR. Upon receiving the off-hook signal, the SR generates an SS7 ANM and passes it to the LSRG PIF. The PIF maps the ANM into a SIP 200 OK message, and passes it to the NIF component of the LSRG. The NIF component passes the 200 OK to the bridge. At this point the caller, transfer-from PSAP and transfer-to PSAP are all participants in the conference.

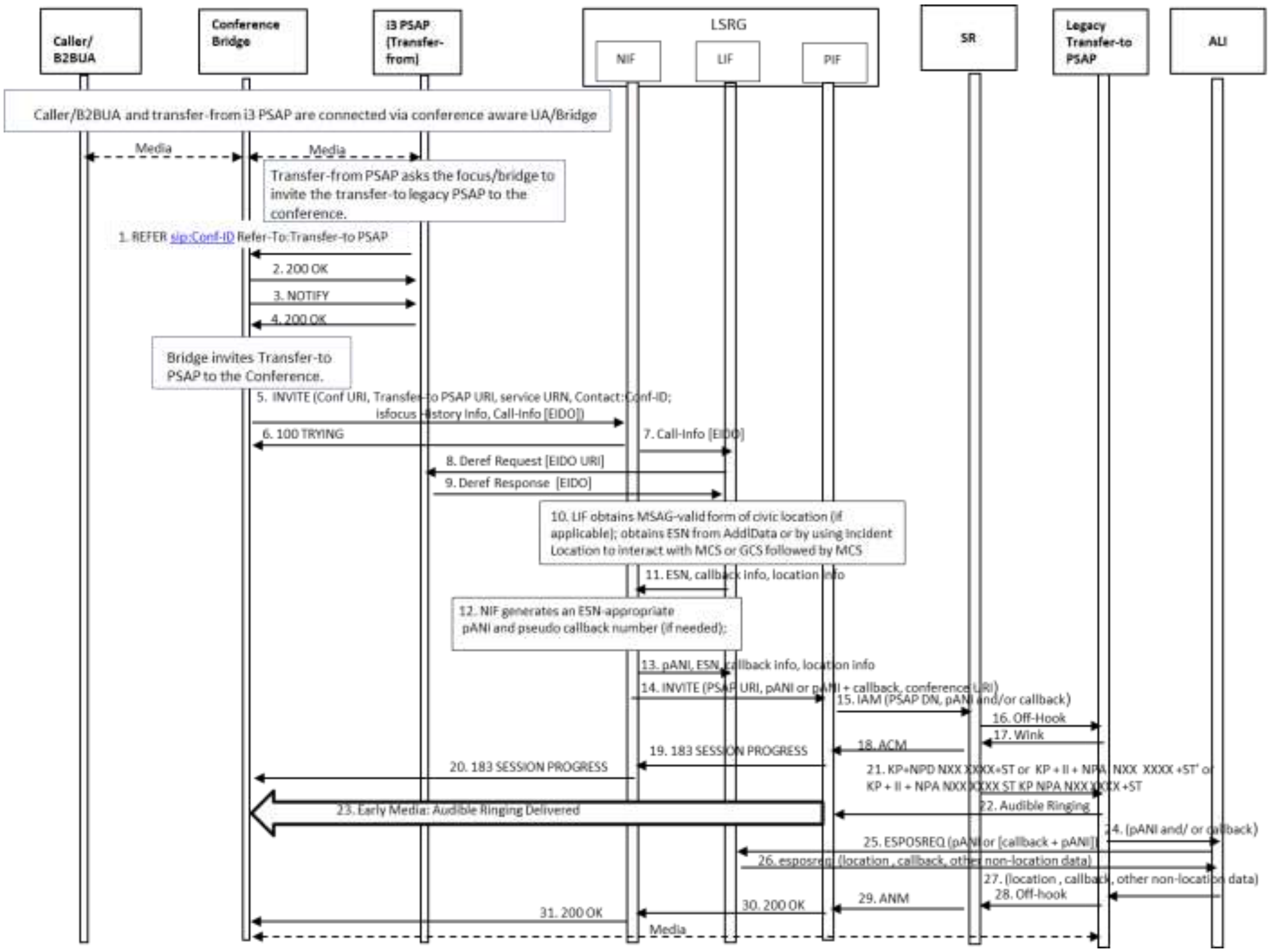


Figure 5-5: Transferred Call, From i3 PSAP to Legacy PSAP on SR – Conference Establishment

In this example, it is assumed that an emergency call has been established between a caller and an i3 PSAP. The i3 PSAP determines that it needs to transfer the call to a legacy PSAP that is served by an SR and establishes a conference with a conference bridge. The i3 PSAP requests that the bridge invite the caller/B2BUA to the conference. The caller/B2BUA and the transfer-from i3 PSAP are connected via the conference bridge.

Step 1. The i3 PSAP requests that the conference bridge invite the transfer-to legacy PSAP to the conference by sending a REFER method to the conference bridge. The REFER method includes the Conf-ID, a Refer-To header field that contains the 10-digit number/address associated with the transfer-to PSAP, expressed as a URI (e.g., sos:psap@lsrg or sip:telno@lsrg user=phone), and an escaped Call-Info header field value containing a reference URI that points to the EIDO data structure and a purpose parameter of "eido".

Step 2. The bridge returns a 200 OK message to the transfer-from PSAP.

Step 3. The bridge then returns a NOTIFY message to the transfer-from PSAP, indicating that subscription state of the REFER request (i.e., active).

Step 4. The transfer-from PSAP returns a 200 OK in response to the NOTIFY message.

Step 5. The bridge then sends an INVITE message toward the LSRG that is interconnected with the SR that is serving the transfer-to PSAP. The INVITE message includes: a From header that contains the URI associated with the conference bridge; a To header and a Route header that contains the transfer-to PSAP URI; a Request-URI that contains an appropriate service URN for the transfer scenario; a Contact header that contains the Conf-Id and an "isfocus" parameter; a History-Info header with a Reason parameter that indicates that the call has undergone diversion; and a Call-Info header that contains a URI which, when de-referenced, can be used to access an EIDO.

Step 6. The NIF component of the LSRG returns a 100 TRYING message to the conference bridge.

Step 7. The NIF component also passes the Call-Info header to the LIF component of the LSRG.

Step 8. The LIF component sends a dereference request to the transfer-from i3 PSAP to obtain the EIDO.

Step 9. The transfer-from i3 PSAP returns the EIDO in a dereference response.

Step 10. The LIF component uses the information returned in the EIDO to identify the callback information, location information, and the ESN that is to be used in processing the transferred call.

If the most current Incident Location conveyed in the EIDO is the same as the Caller Location, and an ESN Additional Data block is present (by value or by reference) in the EIDO, the LIF component SHALL use the ESN in the Additional Data as the ESN for the call.

If the most current Incident Location conveyed in the EIDO is not the same as the Caller location, or an ESN Additional Data block is not present (by value or by reference) in the EIDO, the LSRG SHALL use the most current Incident Location to obtain an ESN for the call. If the most current Incident Location is a civic location, the LIF component will interact with the MCS to obtain the ESN. If the most current Incident Location is in geodetic format, the LSRG will interact with a GCS and use the resulting civic location to interact with an MCS to obtain the ESN for the call.

Step 11. The LIF component passes the ESN, callback information and location information to the NIF component of the LSRG.

Step 12. The NIF component generates an ESN-appropriate pANI and pseudo-callback number (if needed), and associates the pANI with the ESN, callback number and location information.

Step 13. The NIF component passes the pANI, and the associated callback information, location information, and ESN to the LIF to support location requests from legacy ALI databases.

Step 14. The NIF component also sends a SIP INVITE message to the PIF component of the LSRG. The INVITE message includes: a From header that contains the conference URI; a To header and Request-URI that contains the 10-digit number/address associated with the transfer-to PSAP, expressed as a URI; a P-Asserted-Identity header that contains the callback number or pANI, depending on the provisioning associated with the outgoing trunk group to the SR; and, if the SR expects to receive both a callback number and a pANI over the interface from the LSRG, the INVITE message will also include a Geolocation header that contains the pANI and a Geolocation-Routing header set to "no". Note that if the INVITE contains a Geolocation header, the P-Asserted-Identity header will contain the callback number.

Step 15. The PIF component of the LSRG generates an SS7 IAM and sends it to the SR. The IAM contains a 10-digit PSAP number/address associated with the transfer-to legacy PSAP in the Called Party Number parameter, either the callback number or the pANI created by the LSRG in an SS7 Calling Party Number parameter (depending on what was received in the P-Asserted-Identity header of the INVITE message), and if a Geolocation header containing a pANI and a Geolocation-Routing header set to "no" was received in the INVITE from the NIF component, a Generic Digits Parameter that contains the pANI (with the callback number in the SS7 Calling Party Number parameter).

Step 16. Upon receiving the IAM, the SR queries the SRDB with the callback number or pANI (based on provisioning at the SR) to obtain an ESN that can be used to support Selective Transfer (not shown). The SR generates an MF off-hook signal toward the transfer-to legacy PSAP (identified based on the SS7 Called Party Number parameter of the received IAM).

Step 17. The transfer-to legacy PSAP returns a wink signal.

Step 18. Upon receiving the wink signal, the SR generates an SS7 ACM and sends it to the PIF component of the LSRG.

Step 19. In response to the receipt of an SS7 ACM from the legacy SR (with a Called Party Status indicator value set to "in-band information or an appropriate pattern is now available"), the PIF component of the LSRG generates a 183 SESSION PROGRESS message and sends it to the NIF.

Step 20. The NIF component passes the 183 SESSION PROGRESS message to the conference bridge.

Step 21. The SR generates the appropriate Traditional MF or Enhanced MF signaling sequence to deliver the transferred call to the legacy PSAP.

Step 22. Upon receiving complete ANI information from the SR, the PSAP signals the attendant and returns audible ringing toward the conference bridge.

Step 23. Early media/audible ringing is delivered via the LSRG to the conference bridge.

Step 24. The transfer-to legacy PSAP queries the ALI system for location information using the callback number and/or pANI as the key.

Step 25. The ALI system steers the location query to the LSRG by generating and sending an ESPOSREQ message to the LIF component of the LSRG.

Step 26. The LIF component responds by returning an esposreq message to the ALI system that contains location information, callback information, and other non-location information (if available).

Step 27. The ALI system returns the location information, callback information, and other non-location information (if available) to the legacy PSAP.

Step 28. The transfer-to legacy PSAP call taker answers the call and an off-hook signal is conveyed to the SR.

Step 29. The SR generates an SS7 ANM and passes it to the PIF component of the LSRG.

Step 30. The PIF component sends a SIP 200 OK message to the NIF component.

Step 31. The NIF component sends a 200 OK message to the conference bridge.

The caller, transfer-from i3 PSAP and transfer-to legacy PSAP are all participants in the conference and can exchange media.

Once the media session associated with the transfer leg of the call is established, the transfer-from i3 PSAP is notified. The LSRG also subscribes to the conference URI to receive conference status information. When the transfer-from i3 PSAP determines that it should drop off the conference, it sends a BYE message to the conference bridge. The bridge responds by returning a 200 OK. Notification that the transfer-from PSAP has dropped from the conference is conveyed to the transfer-from i3 PSAP, the LSRG and the caller/B2BUA. The caller and the transfer-to legacy PSAP remain in the conference that is being maintained by the conference bridge.

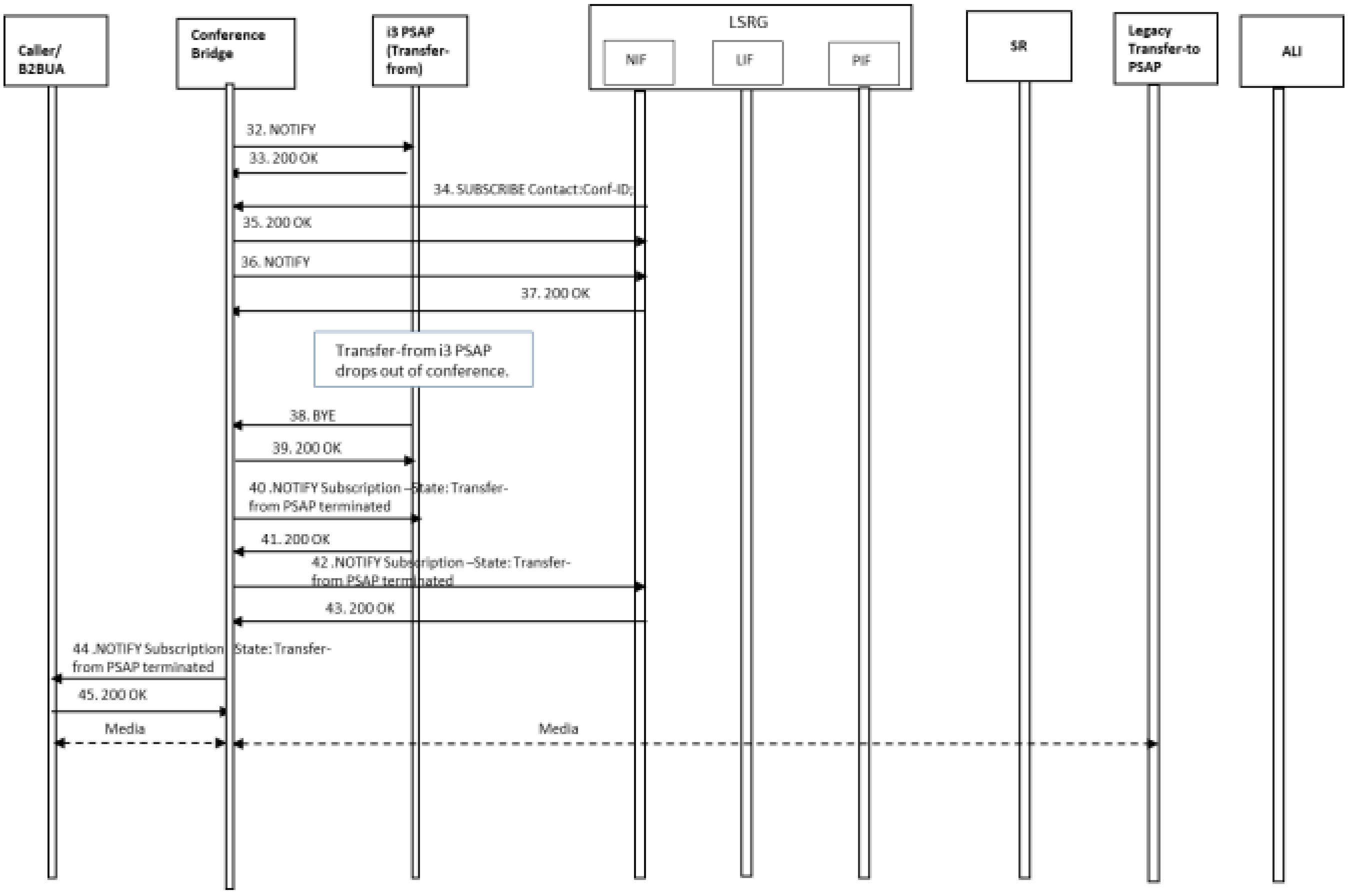


Figure 5-6: Transferred Call, From i3 PSAP to Legacy PSAP on SR – Transfer-from PSAP Drops

Step 32. The conference bridge sends a NOTIFY message to the transfer-from i3 PSAP, informing it that the transfer-to legacy PSAP has joined the conference.

Step 33. The transfer-from i3 PSAP responds by returning a 200 OK.

Step 34. The NIF component of the LSRG sends a subscription request to the conference bridge so that it can receive conference status information.

Step 35. The conference bridge responds by returning a 200 OK.

Step 36. The conference bridge then sends a NOTIFY message to the LSRG providing it the current status of the conference.

Step 37. The LSRG responds by returning a 200 OK.

Step 38. The transfer-from i3 PSAP drops from the conference by returning a BYE to the conference bridge.

Step 39. The conference bridge responds by returning a 200 OK.

Step 40. The conference bridge sends a NOTIFY message to the transfer-from i3 PSAP indicating that the transfer-from i3 PSAP has terminated its participation in the conference.

Step 41. The transfer-from i3 PSAP responds by returning a 200 OK.

Step 42. The conference bridge sends a NOTIFY message to the LSRG indicating that the transfer-from i3 PSAP has terminated its participation in the conference.

Step 43. The LSRG responds by returning a 200 OK.

Step 44. The conference bridge sends a NOTIFY message to the caller/B2BUA indicating that the transfer-from i3 PSAP has terminated its participation in the conference.

Step 45. The caller/B2BUA responds by returning a 200 OK.

The caller/B2BUA and the transfer-to legacy PSAP remain in the conference that is being maintained by the conference bridge.

When the LSRG receives notification that the transfer-from i3 PSAP has dropped from the conference and recognizes that the caller/B2BUA and the transfer-to PSAP are the only remaining participants in the conference, the NIF component of the LSRG completes the transfer (on behalf of the transfer-to legacy PSAP) by sending an INVITE to the caller/B2BUA requesting that they replace their connection to the conference bridge with a direct connection to the LSRG/transfer-to PSAP. (The LSRG learns the URI of the caller/B2BUA through the entity attribute in the endpoint section of the user's container in the conference NOTIFY from the conference bridge.) The caller/B2BUA accepts the request and a media session is established between the caller and the legacy transfer-to PSAP via the LSRG. The caller/B2BUA then sends a BYE to the conference bridge to terminate the session. The LSRG, on behalf of the transfer-to legacy PSAP, also terminates its session with the conference bridge by sending a BYE message to the conference bridge. The bridge then returns a NOTIFY messages to the LSRG and to the caller/B2BUA indicating that the subscription to the conference has been terminated.

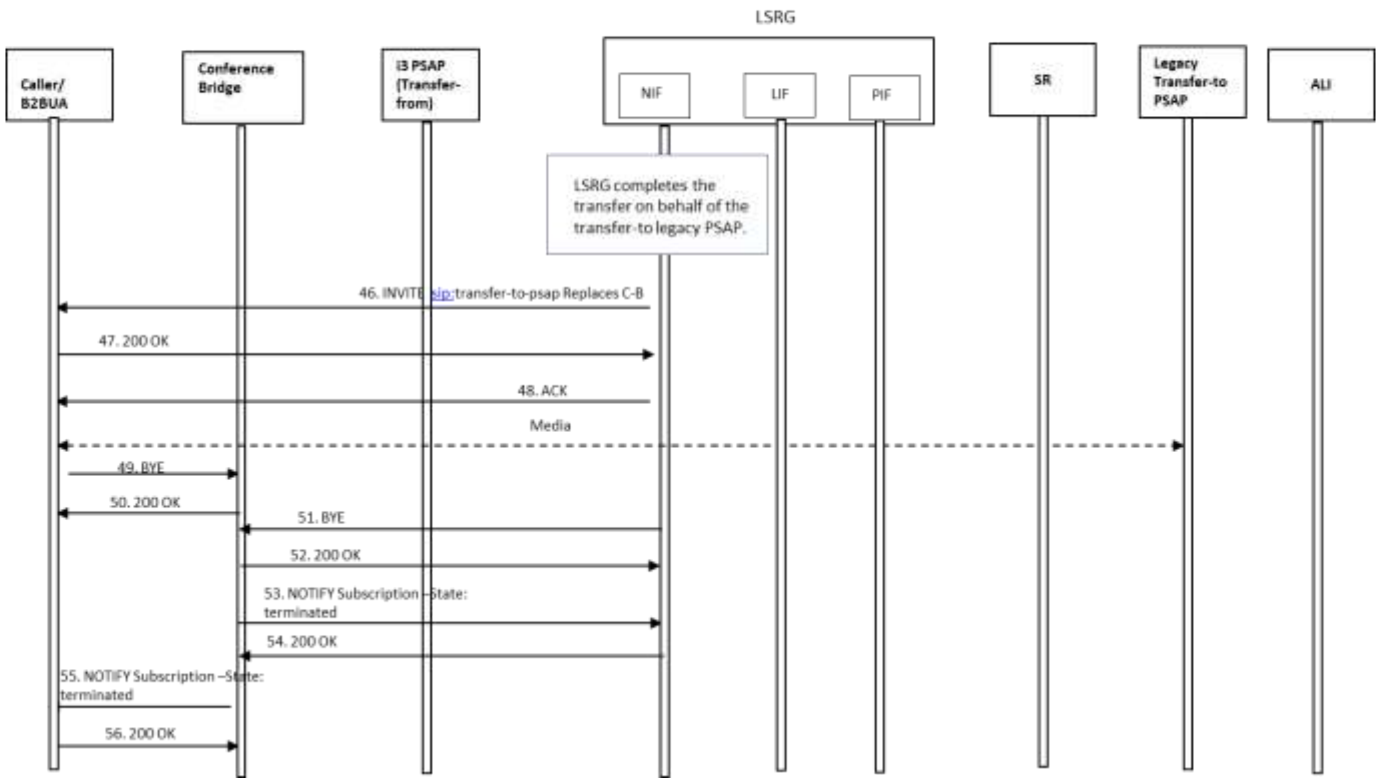
[1] 

Figure 5-7: Transferred Call, From i3 PSAP to Legacy PSAP on SR – LSRG Completes the Transfer

Step 46. Upon recognizing that the caller/B2BUA and the transfer-to PSAP are the only remaining participants in the conference, the LSRG completes the transfer by having the NIF component send an INVITE to the caller/B2BUA that contains a Replaces header that requests that their connection to the bridge be replaced with a connection (via the LSRG) to the legacy transfer-to PSAP.

Step 47. The caller/B2BUA responds by returning a 200 OK message to the NIF component of the LSRG.

Step 48. The NIF component of the LSRG returns an ACK in response to the 200 OK message from the caller/B2BUA.

A media session is established between the caller/B2BUA and the transfer-to legacy PSAP.

Step 49. The caller/B2BUA then sends a BYE to the conference bridge to terminate the session.

Step 50. The conference bridge responds by sending a 200 OK to the caller/B2BUA.

Step 51. The NIF component of the LSRG also terminates the LSRG's/transfer-to legacy PSAP's session with the conference bridge by sending a BYE message to the conference bridge.

Step 52. The conference bridge responds by sending a 200 OK to the NIF component of the LSRG.

Step 53. The conference bridge then returns a NOTIFY message to the NIF component of the LSRG indicating that the subscription to the conference has been terminated.

Step 54. The NIF component of the LSRG returns a 200 OK in response to the NOTIFY message.

Step 55. The conference bridge sends a NOTIFY message to the caller/B2BUA indicating that the subscription to the conference has been terminated.

Step 56. The caller/B2BUA responds by returning a 200 OK.

At this point, the transfer is complete, and the caller and the transfer-to legacy PSAP are involved in a two-way call.

6 LogEvent Changes

6.1 GatewayCallLogEvent

The GatewayCallLogEvent defined in NENA-STA-010 is modified to add an ESN member to it. The revised schema for GatewayCallLogEvent is:

```
GatewayCallLogEvent:
  allOf:
    - $ref: '#/components/schemas/LogEvent'
    - type: object
      properties:
        portTrunkGroup:
          type: string
        pAni:
          type: integer
          format: int32
        digits:
          type: string
        direction:
          $ref: '#/components/schemas/Direction'
        signallingProtocol:
          type: string
        legacyCallId:
          type: string
```

```
        esn:
          type: string
```

6.2 AdditionalDataAddedLogEvent

This document adds a new LogEvent called AdditionalDataAddedLogEvent. The AdditionalDataAddedLogEvent is used when any entity creates a new AdditionalData block and adds it to a call. A "block" member contains the AdditionalData block that was added.

AdditionalDataAddedLogEvent schema is:

```
AdditionalDataAddedLogEvent:
  allOf:
    - $ref: '#/components/schemas/LogEvent'
    - type: object
      properties:
        block:
          type: string
```

7 IANA Actions

This section adds values to the following IANA registries: Geopriv Location Object Method Tokens[21], MIME Media Types[22], Emergency Call Data Types[23], and Emergency Call Additional Data Type of Provider[24].

7.1 New Values for the Geopriv Location Object Method Token Registry

IANA is requested to add the following new values to the Geopriv Location Object Method Token Registry:

Name	Purpose	Reference
hybridOTDOA_AGPS	Hybrid of Observed Time Difference of Arrival and Global Positioning System with Assistance	This document

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

[22] https://www.iana.org/assignments/media-types/media-types.xhtml

[23] https://www.iana.org/assignments/emergency-call-additional-data/emergency-call-additional-data.xhtml#emergency-call-data-types

[24] https://www.iana.org/assignments/emergency-call-additional-data/emergency-call-additional-data.xhtml#service-provider-type

hybridOTDOA_A-GNSS	Hybrid of Observed Time Difference of Arrival and Assisted Global Navigation Satellite Systems	This document

7.2 New Value for the MIME Media Types Registry

IANA is kindly requested to register a new MIME media type per RFC 6838 [47] and RFC 6839 [48]. The use of the "EmergencyCallData" facet is in accordance with RFC 8147 [49].

MIME media type name: application

MIME subtype name: EmergencyCallData.LegacyESN+json

Mandatory parameters: none

Optional parameters: charset

Indicates the character encoding of enclosed JSON.

Encoding considerations: Uses JSON, which can employ 8-bit characters, depending on the character encoding used.

Security considerations: This media type carries a legacy ESN during an emergency call.

This data contains location information. Appropriate precautions should be taken to limit unauthorized access, inappropriate disclosure to third parties, and eavesdropping of this information. Please refer to Section 9 and Section 10 of RFC 7852 [14] for more information.

This media format contains only static information (no active content).

When this media type is contained in an encrypted body part, the enclosing multipart (e.g., multipart/encrypted) has the same Content-ID as the data part. This allows an entity to identify and access the data blocks it is interested in without having to dive deeply into the message structure to decrypt parts it is not interested in. (The 'purpose' parameter in a Call-Info header field identifies the data, and the CID Uniform Resource Locator (URL) points to the data block in the body, which has a matching Content-ID body part header field).

The published specification (see below) contains additional description of the security and privacy considerations.

Interoperability considerations: None

Published specification: [THIS DOCUMENT - - NENA-STA-034.1]

Applications which use this media type: Emergency Services

Additional information: None

Magic Number: None

File Extension: .json

Macintosh file type code: 'TEXT'

Persons and email addresses for further information: Randall Gellens rg+nena.mime@randy.pensive.org

Intended usage: LIMITED USE

Author: This specification is a work item of the National Emergency Number Association (NENA) 911 Core Services Committee, i3 Architecture Working Group.

Change controller: NENA.

7.3 New Value for the Emergency Call Data Types Registry

This specification requests IANA to add the 'LegacyESN' entry to the Emergency Call Data Types registry, with a reference to this document; the 'Data About' value is 'The Location'. The Emergency Call Data types registry was established by RFC 7852 [14].

7.4 New Value for the Type of Provider Registry

This specification requests IANA to add the 'Gateway' entry to the Emergency Call Additional Data Type of Provider registry, with a reference to this document.

Token	Description
Gateway	An element translating/interworking between SIP-based emergency calling and another protocol (e.g., Signaling System 7)

The Emergency Call Additional Data Type of Provider registry was established by RFC 7852 [14].

8 NENA Registry System (NRS) Considerations

Not applicable

9 The Legacy ESN Additional Data Block

This section defines the Legacy ESN additional data block per RFC 7852 [14]. A Legacy ESN additional data block contains an ESN and a 'locality' string indicating the source, locality, or area of significance of the ESN. The ESN is a 3-5 digit integer number encoded as a string. The 'locality' string helps in identifying the ESN's context (since ESNs are local rather than national in scope).

A Legacy ESN Additional Data block is encoded as a JavaScript Object Notation (JSON) [46] object. An ESN additional data block is transported as a MIME object (e.g., in SIP) using the 'application/EmergencyCallData.LegacyESN+json' media type.

9.1 JSON Scheme Description for the Legacy ESN Additional Data Block

The following JSON schema defines the Legacy ESN object:

```
{
   "$schema":      "http://json-schema.org/draft-07/schema#",
   "$id":          "urn:nena:schema:json:EmergencyCallData:LegacyESN:1.0",
   "title":        "EmergencyCallData.LegacyESN",

    "type": "object",
    "properties":
    {

       "esn":
       {
          "description": "A legacy Emergency Service Number as a 3-5 digit
string.",
          "examples":     [ "555" ],
          "minLength":   3,
          "maxLength":   5,
          "type":        "string",
          "pattern":      "^[0-9]{3,5}$"
       },

       "locality":
       {
          "description": "The source, locality, or area of significance of
the ESN.",
          "type":        "string"
       }

    },


    "required": [ "esn" ]

}
```

9.2 Example Legacy ESN Additional Data Block

The following is an example of a valid Legacy ESN object:

```
{
    "esn": "555",
    "locality": "Belcher's Corners, Arachnid County, Maryland"
}
```

9.3 Security and Privacy Considerations for the Legacy ESN Additional Data Block

ESNs have been used within legacy emergency services in North America for decades. ESNs are not directly used within next-generation emergency services, but may be conveyed by next-generation systems interconnected with legacy systems. The information carried in an ESN data block does not introduce new security issues, although it may be advisable for systems to perform a basic sanity check on the values, to avoid sending an invalid ESN to a legacy Selective Router.

A Legacy ESN data block contains only static information; no active content is conveyed.

ESNs are intrinsically associated with a location. As with emergency service systems where location data is supplied or determined with the assistance of an end host, there is the possibility that an ESN is incorrect, either intentionally (e.g., in a denial of service attack against the emergency services infrastructure) or due to a malfunctioning device. The reader is referred to RFC 7378 [50] for a discussion of some of these vulnerabilities.

An ESN is associated with a location, and so should be protected against unauthorized disclosure, as discussed in RFC 7852 [14]. Local regulations may impose additional privacy protection requirements.

9.4 Example Call with a Legacy ESN Additional Data Block

The following is an example INVITE containing a Legacy ESN Additional Data Block:

```
INVITE urn:service:sos SIP/2.0
To: urn:service:sos
From: <sip:+13145551111@example.com>;tag=9fxced76sl
Call-ID: 3848276298220188511@atlanta.example.com
Geolocation: <cid:target123@example.com>
Geolocation-Routing: no
Call-Info: <cid:1234567890@atlanta.example.com>;
           purpose=EmergencyCallData.LegacyESN
Accept: application/sdp, application/pidf+xml,
        application/EmergencyCallData.LegacyESN+json
Allow: INVITE, ACK, PRACK, INFO, OPTIONS, CANCEL, REFER, BYE,
       SUBSCRIBE, NOTIFY, UPDATE
CSeq: 31862 INVITE
```

```
   Content-Type: multipart/mixed; boundary=boundary1
   Content-Length: ...

   --boundary1
   Content-Type: application/sdp

   ...Session Description Protocol (SDP) goes here

   --boundary1
    Content-Type: application/pidf+xml
    Content-ID: <target123@atlanta.example.com>
    Content-Disposition: by-reference;handling=optional

    <?xml version="1.0" encoding="UTF-8"?>
    <presence
       xmlns="urn:ietf:params:xml:ns:pidf"
       xmlns:dm="urn:ietf:params:xml:ns:pidf:data-model"
       xmlns:gp="urn:ietf:params:xml:ns:pidf:geopriv10"
       xmlns:dyn="urn:ietf:params:xml:ns:pidf:geopriv10:dynamic"
       xmlns:gml="http://www.opengis.net/gml"
       xmlns:gs="http://www.opengis.net/pidflo/1.0"
       entity="sip:+13145551111@example.com">
       <dm:device id="123">
           <gp:geopriv>
               <gp:location-info>
                   <gml:Point srsName="urn:ogc:def:crs:EPSG::4326">
                      <gml:pos>-34.407 150.883</gml:pos>
                   </gml:Point>
                    <dyn:Dynamic>
                       <dyn:heading>278</dyn:heading>
                       <dyn:direction><dyn:direction>
                    </dyn:Dynamic>
               </gp:location-info>
               <gp:usage-rules/>
               <method>gps</method>
           </gp:geopriv>
           <timestamp>2012-04-5T10:18:29Z</timestamp>
           <dm:deviceID>1M8GDM9A_KP042788</dm:deviceID>
       </dm:device>
</presence>

    --boundary1
    Content-Type: application/EmergencyCallData.LegacyESN+json
    Content-ID: <1234567890@atlanta.example.com>
    Content-Disposition: by-reference;handling=optional

    {
    "esn": "555",
    "locality": "Belcher's Corners, Arachnid County, Maryland"
    }
```

```
--boundary1--
```

10 Documentation Required for the Development of a NENA XML Schema

Not applicable.

11 Impacts, Considerations, Abbreviations, Terms, and Definitions

11.1 Operations Impacts Summary

The transition to NG9-1-1 will impact operations within all stakeholder organizations. While the objective of including the LSRG in a transitional architecture is to minimize the impacts on originating networks and PSAPs by using existing/standard interfaces into and out of the LSRG, there will be some impacts on legacy Emergency Services Network providers and 9-1-1 Authorities to facilitate emergency call processing at the LSRG.

Since transition will be taking place at all 9-1-1 Authority levels (national, state, regional, local), transition plans will need to be in place, so that every PSAP is covered. The plans will also need to be coordinated to handle all contingencies of various levels of transition. In transition plans that utilize LSRGs, legacy routing will be used to deliver emergency calls to LSRGs on the ingress side of the i3 ESInet/NGCS. Subsequent routing by the LSRG or by i3 ESRPs will use i3 ECRF-based routing. This means that the 9-1-1 Authority must support the Geographic Information System (GIS) data that gets populated in the ECRFs and LVFs, as well as maintaining existing processes for validation and provisioning of legacy systems (e.g., ALIs, Selective Routing Databases [SRDBs]).

Thus, the 9-1-1 Authority for transitioning PSAPs must have the appropriate GIS data including address information, streets, responder boundaries, and other data required for proper validation and routing within the core NG9-1-1 infrastructure and affected PSAPs, and must develop procedures to reconcile legacy location validation and routing databases to NG9-1-1 GIS-based databases.

To support legacy wireless emergency calls that are delivered to an i3 ESInet/NGCS via an ingress LSRG, back-end processes between wireless carriers, the 9-1-1 Authority, and the LSRG provider will have to be established to ensure that ingress LSRGs route legacy wireless originations toward the desired PSAP via the correct ESInet. While the ingress LSRG is expected to query the ALI system for location information (with the query being steered to an MPC/GMLC, as appropriate), the location returned by the ALI system may be appropriate to support dispatch, but not necessarily appropriate to use in routing the emergency call. This is because the location returned by the ALI system will not reflect agreements that one PSAP may have to handle legacy wireless emergency calls on another PSAP's behalf. The 9-1-1 Authority will have to work with the legacy wireless carrier and the LSRG provider to ensure that the Emergency Services Routing Digits (ESRD)/Emergency Services Routing Key (ESRK) delivered to the ingress LSRG with the call, and the routing location that the LSRG associates with that ESRD/ESRK, will cause the emergency call to be routed toward the desired PSAP. This routing location could be a point, address, or polygon that results in the call being directed to the desired PSAP, and once agreed upon between the wireless carrier and the 9-1-1 Authority, would need to be communicated to the LSRG provider so that it can be provisioned in the LSRG system.

11.2 Technical Impacts Summary

In addition to the impacts on 9-1-1 Authorities described above, the introduction of LSRG-based transitional architectures will also impact providers of legacy Emergency Services Networks. The legacy Emergency Services Network provider will be expected to have contractual relationships with the LSRG provider(s) in its serving area to support the processes needed to ensure that emergency calls are placed on the correct trunk using the agreed upon interconnection arrangement, with the appropriate information passed between the legacy Selective Router (SR) and the LSRG. The legacy Emergency Services Network provider must also work with the LSRG provider to establish the desired default, contingency and congestion routing mechanisms, as applicable to the area of service.

In the case of emergency calls originated in networks served by legacy SRs and destined for i3 PSAPs, the legacy Emergency Services Network provider is expected to ensure that the ALI system(s) accessible by the PSAPs they serve are also accessible to the LSRG. This will require that the appropriate data connections be in place to allow communication between the LSRG and the ALI system. The legacy Emergency Services Network provider (and/or the ALI system provider) must inform the LSRG of the query protocol supported by the ALI system. It is expected that the ALI system(s) will be prepared to receive location queries from LSRGs using the same protocol that would be used by a PSAP to query the ALI system.

In the case of emergency calls routed via an ESInet/NGCS for delivery to PSAPs served by legacy SRs, the legacy Emergency Services Network provider (and/or ALI system provider) is expected to ensure that the ALI systems queried by PSAPs served by the legacy SRs support the appropriate data connections to allow the ALI system to query an LSRG using the E2 protocol. It is expected that the ALI system(s) will use the same protocol to query an LSRG as it would to query an MPC/GMLC.

To ensure that location queries are directed to the correct LSRG, legacy E9-1-1 System Service providers (and/or ALI system providers) will be responsible for ensuring that the correct query steering data is populated in an ALI system that may need to query an LSRG.

Legacy E9-1-1 System Service providers (and/or ALI system providers) will also be responsible for ensuring that the caller location data populated in the ALI systems is accurate and up-to-date. This assumes that a business relationship exists between the legacy originating network providers and the legacy Emergency Services Network providers (and/or ALI system providers).

This standard specifies the use of tandem-to-tandem functionally to interwork between the LSRG and the SR. "Tandem-to-tandem" functionality must be enabled in the SR. NENA's 03-003 [3] specification should be used as a guideline for performing the routing. If the legacy E9-1-1 Service Provider has not deployed NENA's 03-003, it may have limited capabilities to interact with the NG9-1-1 ESInet/NGCS. The lack of tandem-to-tandem functionality may require the use of hand-off processes which will limit the interconnection options and functionality

11.3 Security Impacts Summary

The introduction of NG9-1-1 will have significant impacts to security within all of the stakeholder organizations. Fundamentally, the introduction of Internet Protocol (IP)-based networks will require support for new security processes and procedures. During transition, the LSRG will be a critical network element that is responsible for ensuring that emergency calls that are routed via legacy SRs can be completed to i3 PSAPs, and that emergency calls routed via the ESInet can be completed to PSAPs that are served by legacy SRs. This document will focus on mechanisms for keeping the LSRG secure and accessible only by entities that are authorized and have been authenticated.

11.4 Recommendation for Additional Development Work

The FCC Second Report and Order [54], released on October 1, 2020, requires that voice service providers support the STIR/SHAKEN caller ID authentication framework in the IP portions of their networks by June 30, 2021. The Second Report and Order [54] also requires that, by June 30, 2021, non-IP voice service providers either upgrade their networks to support SIP calls and fully implement SHAKEN throughout its network, or that they, upon request of the FCC, provide documented proof that they are participating as members of a working group, industry standards group, or consortium that is working to develop a non-IP caller identification authentication solution. Support for caller authentication in transitional NG9-1-1 architectures that include LSRGs will depend on the availability of non-IP call authentication solutions that accommodate the unique signaling and architectural characteristics of legacy E9-1-1 and transitional NG9-1-1 service architectures. Future work should support call authentication in transitional NG9-1-1 architectures that include LSRGs.

Public Safety must deal with situations where caller location information is spoofed, resulting in significant risks to life and property. Another topic for future work should include the development of a mechanism that will provide an indication to the PSAP of the trustworthiness of the location information associated with a 9-1-1 call. Public Safety would benefit from industry support for a mechanism, comparable to the signing/verification mechanism that has been specified for caller identity information, that would allow a PSAP call taker to better assess the degree to which the location information provided with a 9-1-1 call can be trusted. Assuming location information can be signed and verified, future work will need to assess potential impacts on LSRGs of supporting such a capability.

11.5 Anticipated Timeline

Transition to NG9-1-1 is already underway, but should be viewed as a journey that will be realized at different rates within various parts of North America, based upon state/province, local implementation and stakeholder environment. Some of the transitional architectures currently being deployed include one or more LSRGs. The availability of a NENA standard for the LSRG will facilitate interoperability in transitional architectures that include these elements

11.6 Abbreviations, Terms, and Definitions

See the NENA Knowledge Base for a Glossary of terms and abbreviations used in NENA documents. Abbreviations and terms used in this document are listed below with their definitions.

Term or Abbreviation (Expansion)	Definition / Description
ADR (Additional Data Repository)	An ADR (Additional Data Repository) is a data retrieval facility for Additional Data. The ADR returns an AdditionalData block in response to a dereference of a URI. The URI is obtained in a Call-Info header field, PIDF-LO <provided-by>, or from an ECRF query using "urn:emergency:service:additionalData". An Identity-Searchable Additional Data Repository (IS-ADR) returns Additional Data associated with an identity.
ALI (Automatic Location Identification)	ALI (Automatic Location Identification) is the automatic display at the PSAP of the caller's telephone number, the address/location of the telephone and supplementary emergency services information of the location from which a call originates.
ANI (Automatic Number Identification)	Telephone number associated with the call origination, originally associated with the access line of the caller.
B2BUA (Back-to-Back User Agent)	B2BUA (Back-to-Back User Agent) is a SIP element that relays signaling mechanisms while performing some alteration or modification of the messages that would otherwise not be permitted by a proxy server. A logical entity that receives a request and processes it as a UAS (user agent server). In order to determine how the request should be answered, it acts as a UAC (user agent client) and generates requests. Unlike a proxy server it maintains dialog state and must participate in all requests sent on the dialogs it established.
cid (Content Identifier [Content-ID])	A unique identifier assigned to a body part that allows the body part to be referenced in a SIP header field.
DN (Directory Number)	A dialable 10-digit telephone number associated with a telephone subscriber or call destination.

E2 Interface	E2 Interface is an industry standard interface (defined in J-STD-036) used between a Mobile Positioning Center (MPC/GMLC) and an ALI database server.
E9-1-1 (Enhanced 9-1-1)	E9-1-1 (Enhanced 9-1-1) is a telephone system which includes network switching, database and Public Safety Answering Point premise elements capable of providing automatic location identification data, selective routing, selective transfer, fixed transfer, and a call back number. The term also includes any enhanced 9-1-1 service so designated by the Federal Communications Commission in its Report and Order in WC Docket Nos. 04-36 and 05-196, or any successor proceeding.
EAAC (Emergency Access Advisory Committee)	An advisory committee to the FCC (Federal Communications Commission) charted with determining the most effective and efficient technologies and methods by which to enable equal access to emergency services by individuals with disabilities as part of the nation's migration to Next Generation 9-1-1 (NG9-1-1), and to make recommendations to the Commission on how to achieve those effective and efficient technologies and methods.
ECRF (Emergency Call Routing Function)	ECRF (Emergency Call Routing Function) is a functional element in NGCS (Next Generation Core Services) which 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.
EIDO (Emergency Incident Data Object)	An EIDO (Emergency Incident Data Object) is a JSON-based (JavaScript Object Notation) object that is used to share emergency incident information between and among authorized entities and systems. NENA has adopted the JSON-based EIDO (Emergency Incident Data Object) for sharing incident information among authorized NG9-1-1 entities and systems.
ESInet (Emergency	ESInet (Emergency Services IP Network) is a managed IP network that is used for emergency services communications, and which can be shared by all public safety agencies. It provides the IP transport

Services IP Network)	infrastructure upon which independent application platforms and core services 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). The term ESInet designates the network, not the services that ride on the network. See NG9-1-1 Core Services.
ESME (Emergency Services Message Entity)	ESME (Emergency Services Message Entity) routes and processes the out-of-band messages related to emergency calls. This may be incorporated into selective routers (also known as Routing, Bridging and Transfer switches) and Automatic Location Identification (ALI) database engines.
ESN (Emergency Service Number)	ESN (Emergency Service Number) is a 3-5 digit number that represents one or more ESZs (Emergency Service Zone). An ESN is defined as one of two types: Administrative ESN and Routing ESN
ESQK (Emergency Services Query Key)	ESQK (Emergency Services Query Key) identifies a call instance at a VPC, and is associated with a particular SR/ESN combination. The ESQK is delivered to the E9-1-1 SR and as the calling number/ANI for the call to the PSAP. The ESQK is used by the SR as the key to the Selective Routing data associated with the call. The ESQK is delivered by the SR to the PSAP as the calling number/ANI for the call, and is subsequently used by the PSAP to request ALI information for the call. The ALI database includes the ESQK in location requests sent to the VPC. The ESQK is used by the VPC as a key to look up the location object and other call information associated with an emergency call instance. The ESQK is a non-dialable North American Numbering Plan (NANP) number in the format of NPA-NXX-XXXX. They are currently being allocated from NPA-211-XXXX and NPA-511-XXXX number sets.
ESRD (Emergency Services Routing Digit)	ESRD (Emergency Services Routing Digit) is a 10-digit North American Numbering Plan number that uniquely identifies a base station, cell site, or sector that is used to route wireless emergency calls through the network. The ESRD may also be used by the PSAP to retrieve the associated ALI data.

ESRK (Emergency Services Routing Key)	ESRK (Emergency Services Routing Key) is a 10-digit North American Numbering Plan number that uniquely identifies a wireless emergency call, is used to route the call through the network, and used to retrieve the associated ALI data.
ESRP (Emergency Service Routing Proxy)	ESRP (Emergency Service Routing Proxy) is an i3 functional element which is a SIP proxy server that selects the next hop routing within the ESInet based on location and policy. There is an ESRP on the edge of the ESInet. There is usually an ESRP at the entrance to an NG9-1-1 PSAP. There may be one or more intermediate ESRPs between them.
GCS (Geocode Service)	An NG9-1-1 service providing geocoding and reverse-geocoding.
GDP (Generic Digits Parameter)	GDP (Generic Digits Parameter) identifies the type of address to be presented in calls set up or additional numeric data relevant to supplementary services such as LNP or E9-1-1.
GIS (Geographic Information System)	A system for capturing, storing, displaying, analyzing, and managing data and associated attributes which are spatially referenced.
HCO (Hearing Carry Over)	HCO (Hearing Carry Over) is a method which utilizes both voice and text communications on the same call, allowing a person who has a speech disability to listen to the other party's conversation and respond by typing via a TTY or other means of text communications.
HELD (HTTP-Enabled Location Delivery)	A protocol that can be used to acquire Location Information (LI) from a LIS within an access network as defined in IETF RFC 5985.
HTTPS (Hypertext Transfer Protocol Secure)	HTTP with secure transport (Transport Layer Security or its predecessor, Secure Sockets Layer).
i3	"i3" refers to the NG9-1-1 system architecture defined by NENA, which standardizes the structure and design of Functional Elements making up the set of software services, databases, network

	elements and interfaces needed to process multi-media emergency calls and data for NG9-1-1. See NGCS (Next Generation 9-1-1 Core Services), ESInet (Emergency Services IP Network), and NG9-1-1 (Next Generation 9-1-1).
IAM (Initial Address Message)	The first message sent in a call set-up by a Switch or Exchange to other partner exchange. Refer to http://www.wapopia.com/techfaq/gsm-faq/what-is-initial-address-message-iam/
IANA (Internet Assigned Numbers Authority)	The departmental entity within ICANN (Internet Corporation for Assigned Names and Numbers) that oversees coordination of global IP address allocation, DNS root zone management, protocol name and number registries, and other Internet protocol assignments. Some NENA documents may use IANA Protocol Registries following the processes described in RFC 8126.
IM (Instant Messaging)	A method of communication, generally using text, in which more than a character at a time is sent between parties nearly instantaneously.
IMEI (International Mobile Equipment Identity)	A 15- or 17-digit code that uniquely identifies mobile phone sets. The IMEI code can enable a GSM (Global System for Mobile communication) or UMTS (Universal Mobile Telecommunications Service) network to prevent a misplaced or stolen phone from initiating calls.
IP (Internet Protocol)	IP (Internet Protocol) is the method by which data is sent from one computer to another on the Internet or other networks.
ISDN (Integrated Services Digital Network)	ISDN (Integrated Services Digital Network) is an nternational standard for a public communication network to handle circuit-switched digital voice, circuit-switched data, and packet-switched data.
ISUP (Integrated Services Digital Network User Part)	A message protocol to support call set up and release for interoffice voice call connections over SS7 Signaling.
LbyR (Location-by-Reference)	Location-by-Reference is an identifier that when referenced in the correct manner by an authenticated and authorized entity will yield

	the location of an IP end-point. An example of a location reference is a URI.
LbyV (Location-by-Value)	Location-by-Value is a PIDF-LO containing the location of an IP end-point that can be attributed to a specific point in time in the context of location information to support IP based emergency services.
LIF (Location Interwork Function)	LIF (Location Interwork Function) is the functional component of a Legacy Network Gateway which is responsible for taking the appropriate information from the incoming signaling (i.e., calling number/ANI, ESRK, cell site/sector) and using it to acquire location information that can be used to route the emergency call and to provide location information to the PSAP. In a Legacy PSAP Gateway, this functional component takes the information from an ALI query and uses it to obtain location from a LIS.
LIS (Location Information Server)	LIS (Location Information Server) is a functional element that provides locations of endpoints. A LIS can provide Location-by-Reference, or Location-by-Value, and, if the latter, in geodetic or civic forms. A LIS can be queried by an endpoint for its own location, or by another entity for the location of an endpoint. In either case, the LIS receives a unique identifier that represents the endpoint, for example an IP address, circuit-ID, or Media Access Control (MAC) address, and returns the location (value or reference) associated with that identifier. The LIS is also the entity that provides the dereferencing service, exchanging a location reference for a location value.
LNG (Legacy Network Gateway)	LNG (Legacy Network Gateway) is an NG9-1-1 Functional Element that provides an interface between a non-IP originating network and a Next Generation Core Services (NGCS) enabled network.
LoST (Location-to-Service Translation) Protocol	LoST (Location-to-Service Translation) Protocol is a protocol that takes location information and a Service URN and returns a URI. Used generally for location-based call routing. In NG9-1-1, used as the protocol for the ECRF and LVF.
LPG (Legacy PSAP Gateway)	LPG (Legacy PSAP Gateway) is a signaling and media interconnection point between an ESInet and a legacy PSAP. It plays a role in the delivery of emergency calls that traverse an i3 ESInet to

	get to a legacy PSAP, as well as in the transfer and alternate routing of emergency calls between legacy PSAPs and NG9-1-1 PSAPs. The Legacy PSAP Gateway supports an IP (i.e., SIP) interface towards the ESInet on one side, and a traditional MF or Enhanced MF interface (comparable to the interface between a traditional Selective Router and a legacy PSAP) on the other.
LSRG (Legacy Selective Router Gateway)	The LSRG provides an interface between a 9-1-1 Selective Router and an ESInet, enabling calls to be routed and/or transferred between Legacy and NG networks. A tool for the transition process from Legacy 9-1-1 to NG9-1-1.
LVF (Location Validation Function)	LVF (Location Validation Function) is a functional element in an NGCS that is a LoST protocol server where civic location information is validated against the authoritative GIS database information. A civic address is considered valid if it can be located within the database uniquely, is suitable to provide an accurate route for an emergency call and adequate and specific enough to direct responders to the right location.
MCS (MSAG Conversion Service)	MCS (MSAG Conversion Service) is a web service providing conversion between PIDF-LO (Presence Information Data Format – Location Object) and MSAG (Master Street Address Guide) data.
MDN (Mobile Directory Number)	The 10-digit telephone number that is dialed to reach a CDMA (Code Division Multiple Access) or TDMA (Time Division Multiple Access) cell phone.
MLTS (Multi-Line Telephone System)	MLTS (Multi-Line Telephone System) is communications equipment comprised of common control unit(s), telephone sets, control hardware and software and adjunct systems used typically in enterprise settings such as hotels, government agencies, commercial offices, and campuses. Such equipment includes network and premises-based systems such as Centrex, VoIP, as well as PBX, Hybrid, and Key Telephone Systems (as classified by the FCC under Part 68 Requirements).
MMS (Multimedia Messaging Service)	MMS (Multimedia Messaging Service) is a standard way to send messages that extends the core SMS (Short Message Service)

	capability to include multimedia content to and from a mobile phone over a cellular network.
MPC/GMLC (Mobile Positioning Center / Gateway Mobile Location Center)	MPC/GMLC (Mobile Positioning Center / Gateway Mobile Location Center) is a Functional Entity that provides an interface between the wireless originating network and the Emergency Services Network. The MPC/GMLC retrieves, forwards, stores and controls position data within the location services network. It interfaces with the location server (e.g., Position Determining Entity (PDE)) for initial and updated position determination. The MPC/GMLC restricts access to provide position information only while an emergency call is active.
MSAG (Master Street Address Guide)	MSAG (Master Street Address Guide) is a database of street names and house number ranges within their associated communities defining Emergency Service Zones (ESZs) and their associated Emergency Service Numbers (ESNs) to enable proper routing of 9-1-1 calls.
MSC (Mobile Switching Center)	The wireless equivalent of a Central Office, which provides switching functions for wireless calls.
MSRP (Message Session Relay Protocol)	MSRP (Message Session Relay Protocol) is a standardized mechanism for exchanging instant messages using SIP where a server relays messages between user agents.
MTP (Message Transfer Part)	MTP (Message Transfer Part) is a layer of the SS7 protocol providing the routing and network interface capabilities to support call setup.
NANP (North American Numbering Plan)	NANP (North American Numbering Plan) is an integrated telephone numbering plan serving 20 North American countries that share its resources and are in the +1 country code. NANP numbers are ten-digit numbers consisting of a three-digit Numbering Plan Area (NPA) code, commonly called an area code, followed by a seven-digit local number. The format is usually represented as NXX-NXX-XXXX where N is any digit from 2 through 9 and X is any digit from 0 through 9.
NCAS (Non Call Associated Signaling)	A method for delivery of wireless 9-1-1 calls in which the Mobile Directory Number and other call associated data are passed from the Mobile Switching Center to the PSAP outside the voice path. Also known as: Non Call-path Associated Signaling

	Refer to https://www.techstreet.com/standards/atis-j-std-036-c-2?product_id=1984450#jumps
NENA (National Emergency Number Association)	NENA is the National Emergency Number Association, also referred to as The 9-1-1 Association, which is fully dedicated to the continued improvement and modernization of the 9-1-1 emergency communication system. NENA's approach includes research, standards development, training, education, certification, outreach, and advocacy through communication with stakeholders. As an ANSI accredited Standards Developer, NENA works with 9-1-1 professionals, public policy leaders, emergency services and telecommunications industry partners, like minded public safety associations, and more. Current NENA activities center on awareness, documentation, and implementation for Next Generation 9-1-1 (NG9-1-1) and international three digit emergency communication systems. NENA's worldwide members join with the emergency response community in striving to protect human life, preserve property, and maintain the security of all communities.
NG9-1-1 (Next Generation 9-1-1)	An IP based system comprised of hardware, software, data, and operational policies and procedures that (A) provides standardized interfaces from emergency call and message services to support emergency communications; (B) processes all types of emergency calls, including voice, text, data, and multimedia information; (C) acquires and integrates additional emergency call data useful to call routing and handling; (D) delivers the emergency calls, messages, and data to the appropriate public safety answering point and other appropriate emergency entities; (E) supports data, video, and other communications needs for coordinated incident response and management; and (F) provides broadband service to public safety answering points or other first responder entities.

	Agreed to by NENA, NASNA, iCERT, and the National 9-1-1 Office representatives on 01/12/2018, see: [47 USC 942: Coordination of 9-1-1, E9-1-1, and Next Generation 9-1-1 implementation (house.gov)] Also known as: Next Generation 9-1-1 Services.
NGCS (Next Generation 9-1-1 Core Services)	The set of services needed to process a 9-1-1 call on an ESInet. It includes, but is not limited to, the ESRP, ECRF, LVF, BCF, Bridge, Policy Store, Logging Services, and typical IP services such as DNS and DHCP. The term NG9-1-1 Core Services includes the services and not the network on which they operate. See Emergency Services IP Network.
NIF (NG9-1-1 Specific Interwork Function)	NIF (NG9-1-1 Specific Interwork Function) is the functional component of a Legacy Network Gateway or Legacy PSAP Gateway which provides NG9-1-1 specific processing of the call not provided by an off-the-shelf protocol interwork gateway.
NPA (Numbering Plan Area)	Encoded numerically with a three digit telephone number prefix, commonly called the area code. Each telephone is assigned a seven digit telephone number unique only within its respective plan area. The telephone number consists of a three digit central office code and a four digit station number. The combination of an area code and the telephone number serves as a destination routing address in the public switched telephone network (PSTN)
PAI (P-Asserted-Identity)	A header field in a SIP message containing a URI that the originating network asserts is the correct identity of the caller.
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.

PIDF-LO (Presence Information Data Format - Location Object)	The PIDF-LO (Presence Information Data Format – Location Object) provides a flexible and versatile means to represent location information in a SIP header using an XML schema.
PIF (Protocol Interworking Function)	The PIF (Protocol Interworking Function) is the functional component of a Legacy Network Gateway or Legacy PSAP Gateway that interworks legacy PSTN signaling such as ISUP or CAMA with SIP signaling.
POTS (Plain Old Telephone Service)	The Voice-grade telephone service employing analog signal transmission over twisted pair copper wire.
PSAP (Public Safety Answering Point)	PSAP (Public Safety Answering Point) is an entity responsible for receiving 9-1-1 calls and processing those calls according to a specific operational policy.
RTP (Real Time Protocol)	RTP (Real Time Protocol) is an IP protocol used to transport media (voice, video, text) which has a real time constraint.
RTT (Real Time Text)	RTT (Real Time Text) is a text transmission that is character at a time, as in TTY. Technology that allows consumers to send and receive Internet Engineering Task Force (IETF) RFC 4103 text characters, as they are typed, as well as audio simultaneously.
SDP (Session Description Protocol)	SDP (Session Description Protocol) is a standard syntax contained in a signaling message to negotiate a real time media session.
SIF (Signaling Information Field)	The signaling information field is a block of bits that are contained within an SS7 message signal unit (MSU) which carries information related to a certain user transaction and is identified by a label.
SIO (Service Information Octet)	The service information octet is an eight bit data field that is contained in an SS7 message signal unit (MSU) which comprises the service indicator and the sub-service field.

SIP (Session Initiation Protocol)	SIP (Session Initiation Protocol) is a protocol specified by the IETF (RFC 3261) that defines a method for establishing multimedia sessions over the Internet. Used as the call signaling protocol in VoIP, NENA i2 and NENA i3.
SLS (Signaling Link Selection)	A field in the routing lable of the SS7 Message Transfer Part that is typically used by the message routing function to perform load sharing among different signaling links or link sets.
SMS (Short Message Service)	SMS (Short Message Service) is a service typically provided by mobile carriers that sends short (160 characters or fewer) messages to an endpoint. SMS is often fast but is not real time.
SR (Selective Router)	SR (Selective Router) is the Central Office that provides the tandem switching of 9-1-1 calls. It controls delivery of the voice call with ANI to the PSAP and provides Selective Routing, Speed Calling, Selective Transfer, Fixed Transfer, and certain maintenance functions for each PSAP.
SRDB (Selective Routing Database)	The routing table that contains telephone number to ESN relationships which determines the routing of 9-1-1 calls.
SS7 (Signaling System 7)	SS7 (Signaling System 7) is an out-of-band signaling system used to provide basic routing information, call set-up and other call termination functions. Signaling is removed from the voice channel itself and put on a separate data network.
TDM (Time-division multiplexing)	A digital multiplexing technique for combining a number of signals into a single transmission facility by interweaving pieces from each source into separate time slots.
TTY (Teletypewriter)	A TTY (Teletypewriter) is a device or application used to send or receive character by character communication using Baudot signaling.
URI (Uniform Resource Identifier)	URI (Uniform Resource Identifier) is an identifier consisting of a sequence of characters matching the syntax rule that is named <URI> in RFC 3986. It enables uniform identification of resources via a set of naming schemes. A URI can be further classified as a

	locator, a name, or both. The term "Uniform Resource Locator" (URL) refers to the subset of URIs that, in addition to identifying a resource, provides a means of locating the resource by describing its primary access mechanism (e.g., its network "location"). The term "Uniform Resource Name" (URN) has been used historically to refer to both URIs under the "urn" scheme [RFC2141], which are required to remain globally unique and persistent even when the resource ceases to exist or becomes unavailable, and to any other URI with the properties of a name. An example of a URI that is neither a URL nor a URN is sip:psap@example.com.
URL (Uniform Resource Locator)	A type of URI, specifically used for describing and navigating to a resource (e.g., https://www.nena.org)
URN (Uniform Resource Name)	A type of URI. Uniform Resource Names (URNs) are intended to serve as persistent, location-independent, resource identifiers and are designed to make it easy to map other namespaces (which share the properties of URNs) into URN-space. An example of a URN is urn:service.sos. See RFC 2141.
VCO (Voice Carry Over)	VCO (Voice Carry Over) is a technology which utilizes both voice and text or video communications, allowing a person with a hearing disability to speak to the other party and read their responses simultaneously as typed or signed by the communications assistant via a text or video-capable device.
VoIP (Voice over Internet Protocol)	VoIP (Voice over Internet Protocol) is a technology that permits delivery of voice calls and other real-time multimedia sessions over IP networks.
VPC (VoIP Positioning Center)	The VoIP Positioning Center (VPC) is the element that provides routing information to support the routing of VoIP emergency calls, and cooperates in delivering location information to the PSAP over the existing ALI DB infrastructure.
VSP (VoIP Service Provider)	A company that offers VoIP telecommunications services that may be used to generate a 9-1-1 call, and interconnects with the 9-1-1 network.

WCM (Wireline Compatibility Mode)	A wireless 9-1-1 signaling arrangement in which an ESRK (Emergency Services Routing Key) is sent as the ANI (Automatic Number Identification) over dedicated trunks to the Selective Router.
WSP (Wireless Service Provider)	A company that offers transmission services to users of mobile devices through radio frequency (RF) signals rather than through end-to-end wire communication.

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13 Exhibits

Not applicable.

Appendix A Support for PSAP Call Control Features (Normative)

This document does not place any specific requirements on originating networks, however the procedures in this Appendix are based on a set of assumptions regarding the signaling generated by a legacy or SIP-based originating network toward an i3 ESInet/NGCS in support of PSAP Call Control Features when the originating network and/or the PSAP is served by a legacy Selective Router. The text in this section describes assumptions related to originating networks so that the reader will better understand the procedures associated with i3 Functional Elements and PSAPs that are normatively described in subsequent sections of this Appendix.

A.1 Assumed Behavior in a Legacy Originating Network

A.1.1 SS7 Signaling from Originating End Office

If Called Party Hold/Switch-hook Status is supported in a legacy origination network that uses outgoing SS7-supported trunks from the originating end office for emergency calls, it is assumed that the originating network will signal the availability of the Called Party Hold feature by generating an SS7 Initial Address Message (IAM) toward a Legacy Network Gateway (LNG) or legacy Selective Router (SR) that contains a Service Activation Parameter (SAP) with a Feature Code Indicator (FCI) set to "hold available", as described in ATIS-1000628.a.2001(2010) [34] and ATIS-1000666.1999 (2014) [35]. If connection hold is desired/required for the call, the originating network expects to receive a SAP parameter with a FCI set to "hold request" in an SS7 Address Complete Message (ACM) (or SS7 Facility [FAC] message if an ACM has already been received for that circuit) from the LNG or SR. If Called Party Hold is active for an emergency call, and the emergency caller attempts to disconnect from the call, the legacy originating switch will generate an SS7 FAC message that contains a SAP with an FCI indicating "disconnect request". In response to this FAC message, the legacy originating switch will either receive an SS7 FAC message that contains a SAP with an FCI set to "hold continuation request" (if the PSAP wishes to maintain the existing connection) or an SS7 Release (REL) message (if the PSAP wishes to release the connection).

If the emergency caller goes off-hook after the "disconnect request" has been sent, and an SS7 REL has not yet been received, the legacy originating switch will generate an SS7 FAC message that contains a SAP with an FCI indicating "reconnect request".

The procedures described above are also expected from originating networks supporting Enhanced Called Party Hold. Note that Enhanced Called Party Hold requires the addition of an ECPH timer downstream from the originating network. When the ECPH timer expires prior to the call being answered at the PSAP, the legacy originating switch may receive an SS7 FAC message containing a SAP with a FCI indicating "hold release request".

When the Ringback feature is invoked by the PSAP attendant on a held connection in an originating network that supports PSAP Call Control features and call delivery via SS7-controlled trunk groups, it is expected that the originating network will be capable of receiving and processing an SS7 FAC message that contains an FCI indicating "Ringback request" and will apply the appropriate treatment towards the caller depending on the call state (ringing for on-hook, or Receiver-Off-Hook [ROH], also known as "howler" tone, for off-hook). In this scenario, the originating network is expected to supply audible ringing back towards the PSAP.

A.1.2 MF Signaling from Originating End Office

If Called Party Hold/Switch-hook Status is supported in a legacy origination network that uses outgoing MF trunk groups from the originating end office for emergency calls, then upon receiving an off-hook signal from the caller followed by the digits "911", the end office will seize an outgoing trunk to an LNG or SR. When the originating end office receives a wink back from the LNG/SR, the end office will outpulse the called number (i.e., KP + 911 + ST), and will wait for an ANI request signal. Upon receiving the ANI request signal, the end office will outpulse the ANI sequence using CAMA (I + 7-digit ANI) or Feature Group D operator-type (II + 7/10-digit ANI) MF signaling. While the PSAP is being alerted, audible ringing will be delivered to the caller. When the PSAP answers the call, an answer ("off-hook") signal will be delivered to the originating end office.

If an emergency caller subsequently goes on-hook, an "on-hook" signal will be sent forward by the originating switch. Feature-specific processing of the MF signals generated by the end office will be applied by downstream elements based on trunk group provisioning. Since Called Party Hold/Switch-hook Status is supported by the legacy originating switch, the connection to the LNG/SR is expected to be maintained.

If the caller subsequently goes off-hook, an "off-hook" signal will be sent forward, and the behavior of downstream elements will be determined based on provisioning associated with the outgoing MF trunk group.

If the Ringback feature is invoked by the PSAP attendant on a held connection in an originating network that supports MF trunking out of the end office, it is expected that the originating network will pass the appropriate treatment, as applied by the downstream element (i.e., the LNG or SR), towards the caller. If an off-hook Ringback is invoked by a PSAP attendant on an established connection, the originating network is expected to pass the appropriate treatment (e.g., ROH/howler tone) as applied by the LNG/SR through to the caller. If the on-hook Ringback feature is invoked by the PSAP attendant on a held connection to an LNG or SR (via a Legacy Selective Router Gateway) associated with an emergency call that was delivered via an MF trunk group out of the end office, it is expected that normal ringing will be used to alert the caller to the Ringback attempt. As described in Section C.4.4.2 of NENA-STA-010.3 [43] and Section A.4.4.2 of this document, the PIF component of the LNG or LSRG will also return a SIP 180 Ringing message to the NIF component in response to an incoming re-INVITE message containing an Alert-Info header from the NIF component. Note that neither the originating network nor the LNG/LSRG/SR will provide audible ringing toward the PSAP in this case.

A.2 Assumed Behavior in a SIP-based Originating Network

If an IP originating network is operating in a jurisdiction where Called Party Hold/Switch-hook Status is supported, this Appendix assumes that the IP-based originating network will behave in one of the following ways:

1. The SIP-based originating network follows the procedures defined in PKT-SP-RSTF-C01-140314 [36] and PKT-SP-CMSS1.5-I07-120412 [37]. According to Section 8.5.5.8 of PKT-SP-RSTF-C01-140314 [36], because only the PSAP knows if the network hold feature is in effect, the originating network must assume that network hold could be applied. Therefore, the originating network processing of a disconnect request from the calling user will be different from normal disconnect processing if it occurs after the PSAP has answered the call. Specifically, upon receiving a disconnect request from the caller after the PSAP has answered the call, the originating network is expected to send a SIP re-INVITE containing an associated SDP with attribute a= "inactive" and a Priority header set to "emergency", and set a Network Hold timer. If the user subsequently attempts to reconnect to the call, the originating network is expected to send a re-INVITE with an updated SDP offer and stop the Network Hold timer. If the originating network receives 200 OK responses to the re-INVITE messages, it will interpret these as indications of acceptance of the associated media offers.

   If the originating network supports Enhanced Called Party Hold, it is expected to set an ECPH timer at call setup time. Upon receiving a disconnect request from the caller before the PSAP has answered the call, the originating network will send a SIP UPDATE with an associated SDP "aaa" attribute set to "inactive" and a Priority header set to "emergency". If the user subsequently attempts to reconnect to the call prior to a PSAP answer, the originating network is expected to send an UPDATE with an updated SDP offer. If the originating network receives 200 OK responses to the UPDATE messages, it will interpret these as indications of acceptance of the associated media offers. If the originating network receives the 200 OK response to the original INVITE, it will cancel the ECPH timer, if not expired. The originating network is expected to process received SIP BYE messages as specified in RFC 3261 [13]. If the Network Hold timer expires before the user attempts to reconnect to the call, the originating network is expected to generate a SIP BYE message. Additionally, if the ECPH timer expires before the call is answered by the PSAP attendant, the originating network is expected to generate a SIP CANCEL message.

If the originating network receives a re-INVITE message that contains an Alert-Info header (i.e., as a result of a Ringback request being initiated by the PSAP), the originating network is expected to apply the associated Ringback alerting treatment (i.e., regular ringing or receiver off-hook/howler tone, as identified in the ringing tone URI included in the Alert-Info header) to the emergency caller. The originating network is also expected to return a SIP 180 Ringing message to/toward the i3 PSAP, Legacy PSAP Gateway (LPG) or egress LSRG. Note that the originating network should not provide audible ring to the PSAP.

2. Alternatively, the SIP-based originating network may follow the procedures defined between the LSRG-NIF and the NGCS in sections A.3.1.1.3, A.3.1.2.3, and A.3.4.1. Additionally, because such originating networks may support nomadic devices, additional procedures are required to confirm whether the features can be supported end-to-end. This is accomplished by including the media feature tag "urn:emergency:media-feature.psap-call-control" in a Contact header of the original SIP INVITE and any subsequent requests in-dialog. A PSAP, LPG, or egress LSRG supporting PSAP Call Control features will include the same media feature tag value in all response messages (provisional and final) sent within the dialog, beginning with the 180 Ringing or 183 Session Progress message (as appropriate based on the procedures in Section 3.1.1.3). If both parties have received the media feature tag, they must assume that PSAP Call Control features are in effect. From this point, the originating network processing of a disconnect request from the calling user will be different from normal disconnect processing if it occurs after the PSAP has answered the call. Specifically, upon receiving a disconnect request from the caller after the PSAP has answered the call, the originating network is expected to send a SIP re-INVITE containing an associated SDP with attribute "a=suspended" and set a Network Hold timer. If the user subsequently attempts to reconnect to the call, the originating network is expected to send a re-INVITE with an updated SDP offer with attribute "a=sendrecv" and stop the Network Hold timer. If the originating network receives 200 OK responses to the re-INVITE messages, it will interpret these as indications of acceptance of the associated media offers.

   If the originating network supports Enhanced Called Party Hold, it is expected to set an ECPH timer at call setup time. Upon receiving a disconnect request from the caller before the PSAP has answered the call, the originating network will send a SIP UPDATE with an associated SDP with attribute "a=suspended". If the disconnect occurs before the response to the original INVITE is received and if that response does not contain the media feature tag "urn:emergency:media-feature.psap-call-control", the originating network is expected to immediately send a SIP CANCEL and cancel the ECPH timer. If the disconnect occurs after a response to the original INVITE containing the media feature tag is received and the user subsequently attempts to reconnect to the call prior to PSAP answer, the originating network is expected to send an UPDATE with an updated SDP offer with attribute "a=sendrecv". If the originating network receives 200 OK responses to the initial INVITE and subsequent UPDATE messages, it will interpret these as indications of acceptance of the associated media offers and cancel the ECPH timer.

The originating network is expected to process received SIP BYE messages as specified in RFC 3261 [13]. If the Network Hold timer expires before the user attempts to reconnect to the call, the originating network is expected to generate a SIP BYE message. Additionally, if the ECPH timer expires before the call is answered by the PSAP attendant, the originating network is expected to generate a SIP CANCEL message.

If the originating network receives a re-INVITE message that contains an Alert-Info header (i.e., as a result of a Ringback request being initiated by the PSAP), the originating network is expected to apply the associated Ringback alerting treatment (i.e., regular ringing or receiver off-hook/howler tone, as identified in the ringing tone URI included in the Alert-Info header) to the emergency caller. If Ringback is signaled through the "P-DCS-OSPS:RING" header[25], the originating network is expected to apply the appropriate Ringback alerting treatment based on its knowledge of the hook state of the calling device. The originating network is also expected to return a SIP 180 Ringing message to/toward the i3 PSAP, LPG or egress LSRG. Note that the originating network should not provide audible ringing to the PSAP.

3. The originating network does not support any Called Party Hold/Enhanced Called Party Hold/Switch-hook Status-specific call handling procedures. If a disconnect request is received from the caller, the UA generates a SIP BYE message (or SIP CANCEL if the 200 OK response has not been received), as specified in RFC 3261 [13]. It is expected to follow the procedures specified in RFC 6881 [38] for handling emergency call originations.

[25] See Section A.4.1for further details.

A.3 Called Party Hold/Switch-hook Status

A.3.1 Procedures at an Ingress Legacy Selective Router Gateway

A.3.1.1 SS7 Signaling from Originating End Office to Legacy SR

When a legacy originating switch receives an emergency call origination and determines that the Called Party Hold feature may be requested by an emergency services network, and the originating switch can support the Called Party Hold feature for the outgoing circuit, the SS7 Initial Address Message (IAM) delivered by the originating switch to the legacy SR MAY contain a Feature Code Indicator in the Service Activation Parameter (SAP) set to "hold available".

A.3.1.1.1 SS7 Signaling from Legacy SR to Ingress LSRG

If, after interacting with a Selective Routing Database (SRDB) using information received in the incoming IAM, the legacy SR subsequently determines that the route to the destination PSAP for the emergency call is via a tandem-to-tandem trunk group to an ingress LSRG, the SR will pass the IAM with the Feature Code Indicator in the SAP set to "hold available" (if present in the received IAM) to the PIF component of the ingress LSRG.

A.3.1.1.2 Procedures at the Ingress LSRG-PIF Component

Upon receiving an IAM with a SAP, the PIF component of the ingress LSRG SHALL follow the procedures in Section 3.1.1.2 and 3.1.2.1 with the following modifications. If the PIF component receives an IAM that contains a SAP, the PIF component of the ingress LSRG SHALL encapsulate the IAM in the INVITE sent to the NIF component, including the encapsulated message in the body of the INVITE following the procedures specified in Section 5.4.1.2 of ATIS-1000679.2015 [20].

In addition, the PIF component SHALL be capable of receiving a 180 Ringing message from the NIF component that includes an encapsulated ACM message that contains a SAP parameter with a Feature Code Indicator set to "hold request" in the body. The PIF component SHALL generate an ACM, based on the received 180 Ringing message, and SHALL include a SAP parameter with Feature Code Indicator set to "hold request" in the outgoing ACM.

The PIF component SHALL also be capable of receiving a 183 Session Progress message from the NIF component that includes an encapsulated ACM message that contains a SAP parameter with a Feature Code Indicator set to "hold request" in the body. The PIF component SHALL generate an ACM, based on the received 183 Session Progress message, and SHALL include a SAP parameter with Feature Code Indicator set to "hold request" in the outgoing ACM.

If the PIF component subsequently receives an SS7 Facility (FAC) message associated with the incoming SS7-supported trunk group over which the emergency call origination was received from the SR, it SHALL encapsulate the FAC message in a SIP INFO (RFC 6086 [39]) message, as described in Section 5.4.3 of ATIS-1000679.2015 [20] and send it to the NIF component. This may occur if an emergency call has been established, Called Party Hold is active on that call, and the switch-hook status of the emergency caller changes. If the emergency caller attempts to disconnect from the call (i.e., goes "on-hook"), the FAC message MUST contain a Feature Code Indicator in the SAP set to "disconnect request". If the emergency caller subsequently goes "off-hook", the PIF component SHALL receive a FAC that contains a Feature Code Indicator in the SAP set to "reconnect request".

If the PIF component receives a SIP INFO message containing an encapsulated FAC message from the NIF component, the PIF component SHALL generate an SS7 FAC message based on the encapsulated FAC message and send it to the SR.

If, at any time, the PIF component receives a SIP BYE message from NIF component, the PIF component SHALL process that SIP BYE message as described in Section 3.1.4.1. If, at any time, the PIF component receives an SS7 REL message from the legacy SR, the PIF component SHALL respond by sending a RLC to the legacy SR and generating a SIP BYE message and sending it to the NIF component, as described in Section 3.1.1.2.

A.3.1.1.3 Procedures at the Ingress LSRG NIF Component

Upon receipt of an INVITE message from the PIF component containing an encapsulated IAM, the NIF component SHALL follow the procedures in Sections 3.2.1, 3.2.1.1 and 3.2.1.3 with the following modifications.

The INVITE message generated by the NIF component SHALL include the encapsulated IAM and a media feature tag set to "urn:emergency:media-feature.psap-call-control" in the Contact header.

If, the NIF component receives a 180 Ringing message from the NGCS that contains a media feature tag with the value "urn:emergency:media-feature.psap-call-control", indicating that the destination to which the call was delivered supports PSAP Call Control Features, and the 180 Ringing message does not contain an encapsulated ACM, the NIF component SHALL generate and send a 180 Ringing message to the PIF component that contains an encapsulated ACM in the body of that message. If the NIF component receives a 183 Session Progress message from the NGCS that contains a media feature tag with the value "urn:emergency:media-feature.psap-call-control", indicating that the destination to which the call was delivered supports PSAP Call Control Features, and the 183 Session Progress message does not contain an encapsulated ACM, the NIF component SHALL generate and send a 183 Session Progress message to the PIF component that contains an encapsulated ACM in the body of that message. In either case, the NIF component SHALL populate the encapsulated ACM following the procedures described in Section 3.1.1.2 and SHALL also include a SAP with a Feature Code Indicator set to "hold request" in the encapsulated ACM message.

If the NIF component receives a 180 Ringing or 183 Session Progress message that contains an encapsulated ACM, the NIF component SHALL follow the procedures in Section 7.2.1 or 7.2.2, respectively, of ATIS-1000679.2015 [20] for sending a 180 Ringing or 183 Session Progress message to the PIF component.

If the NIF component receives a SIP INFO message from the PIF component, associated with the same emergency call that contains an encapsulated FAC message with the Feature Code Indicator in the SAP set to "disconnect request," the NIF component SHALL generate a re-INVITE message that contains SDP with an "a= suspended" attribute[26]. The re-INVITE message MUST reference the existing dialog so that the i3 PSAP (or LPG or egress LSRG, in the case of a legacy PSAP) knows that it is to modify an existing session instead of establishing a new session. The re-INVITE message SHALL include the following information:

- A Request-URI that contains the information provided in the Contact header of the 200 OK message that was returned in response to the original INVITE message;
- A To header that contains the same information as the original INVITE message (i.e., the digits "911");
- A From header that contains the same information as in the original INVITE message;
- A Via header that is populated with the element identifier (see Section 2.1.3 of NENA-STA-010.3 [43]) for the LSRG;
- A Route header that contains the same information as in the original INVITE (i.e., the ESRP URI obtained from the ECRF);

[26] Note that the use of a re-INVITE that contains an SDP offer indicating that the originator of the re-INVITE no longer wishes to receive media is consistent with the procedures described in Section 9.2 of RFC 3398 [40]. The use of an "a=" attribute value of "suspended" in the SDP will allow the entity receiving the re-INVITE to associate the message with a disconnect request issued by an emergency caller that is subject to PSAP Call Control features.

- A Contact header that contains the same information as in the original INVITE message (i.e., a SIP URI associated with the LSRG), along with a "urn:emergency:media-feature.psap-call-control" media feature tag;
- An SDP with an "a = suspended" attribute to identify that this is related to PSAP Call Control Features.

Upon receiving a 200 OK message from the i3 PSAP/LPG/egress LSRG (via the NGCS), indicating that it accepts the change, the NIF component SHALL respond to the 200 OK by returning an ACK message toward the i3 PSAP/LPG/egress LSRG. The NIF component SHALL also send a SIP INFO message to the PIF component that contains an encapsulated FAC message with the Feature Code Indicator in the SAP set to "hold continuation request" and will repeat this periodically (e.g., every minute or so) to maintain the connection to the legacy originating network via the SR.

If the NIF component receives a SIP INFO message from the PIF component, associated with the same emergency call, that contains an encapsulated FAC message with the Feature Code Indicator in the SAP set to "reconnect request", the NIF component SHALL generate a re-INVITE message with a new SDP offer that contains an attribute of "a=sendrecv". The re-INVITE SHALL contain the same information listed above, except that the SDP will contain the new offer.

Upon receiving a 200 OK message from the i3 PSAP/LPG/egress LSRG indicating that it accepts the change, the NIF component will respond to the 200 OK by returning an ACK message toward the i3 PSAP/LPG/egress LSRG to acknowledge receipt of the SIP 200 response and to confirm the media has been reactivated.

A.3.1.2 MF Signaling from Originating End Office to Legacy SR

Upon receiving a trunk seizure (off-hook) from the originating end office, the legacy SR will return a wink back to the end office. After receiving the called number sequence (i.e., KP + 911 + ST), the SR will generate an ANI request signal and await the ANI sequence. If CAMA-type signaling is used on the MF trunk from the originating end office to the SR, the SR will be capable of receiving and processing an ANI sequence that consists of "I + 7-digit ANI". If Feature Group D operator-type signaling is used on the MF trunk from the legacy end office to the SR, the SR will be capable of receiving and processing an ANI sequence consisting of "II + 7/10-digit ANI". The SR will use the ANI information received via MF signaling to query an SRDB.

A.3.1.2.1 SS7 Signaling From Legacy SR to Ingress LSRG PIF

If the legacy SR subsequently determines that the route to the destination PSAP for the emergency call is via a tandem-to-tandem trunk group to an ingress LSRG, the SR will generate an IAM toward the PIF component of the ingress LSRG, following the procedures described in Section 3.4.2 of GR-317-CORE [45], with the following clarification. If the provisioning associated with the incoming MF trunk group indicates that Called Party Hold/Switch-hook Status is supported, the SR will include a SAP in the outgoing IAM, with a Feature Code Indicator set to "hold available".

If the legacy SR receives an "on-hook" indication from the originating end office switch associated with an existing emergency call delivered over an MF trunk group, the SR will use trunk group provisioning to determine its subsequent behavior. If the provisioning associated with the incoming MF trunk group indicates that Called Party Hold/Switch-hook Status is supported, the SR will generate an SS7 FAC message with a Feature Code Indicator in the SAP set to "disconnect request" and will maintain the connection to the originating end office switch. If the emergency caller subsequently goes "off-hook", the SR will generate a FAC that contains a Feature Code Indicator in the SAP set to "reconnect request".

If the provisioning associated with the incoming MF trunk group indicates that Called Party Hold/Switch-hook Status is not supported, and an "on-hook" signal is received from the originating end office associated with an existing emergency call delivered over an MF trunk group, the SR will follow the procedures described in Section 3.4.2.2 of GR-317-CORE [45] and send a REL message to the PIF component of the ingress LSRG.

A.3.1.2.2 Procedures at the Ingress LSRG-PIF Component

Upon receiving an IAM with a SAP, the PIF component of the ingress LSRG SHALL follow the procedures described in Section A.3.1.1.2.

A.3.1.2.3 Procedures at the Ingress LSRG-NIF Component

Upon receipt of an INVITE message from the PIF component, the NIF component SHALL follow the procedures in Section A.3.1.1.3 for processing that INVITE message and sending an INVITE to the NGCS.

A.3.2 Procedures at the ESRP

If the ESRP is stateful (i.e., has been identified in record routing), and is therefore in the path of the re-INVITE messages, the ESRP SHALL follow normal procedures, as described in RFC 3261 [13] for passing SIP re-INVITE messages and related responses (200 OK and ACK) associated with requests for Called Party Hold where the originating network and the PSAP support feature-specific signaling.

The ESRP SHALL also follow normal procedures, as described in RFC 3261 [13] for passing SIP BYE messages and Contact headers.

A.3.3 Procedures at the i3 PSAP

If an i3 PSAP is operating in a jurisdiction where PSAP Call Control features are supported/required, it SHALL be capable of interpreting the presence of a media feature tag[27] of "urn:emergency:media-feature.psap-call-control"[28] in a Contact header of the original INVITE (and any subsequent requests in-dialog) as an indication from the originating network that it supports PSAP Call Control features. An i3 PSAP operating in a jurisdiction where PSAP Call Control features are supported/required SHALL include a media feature tag of "urn:emergency:media-feature.psap-call-control" in the Contact header of all responses to that original INVITE, and any subsequent requests in-dialog, beginning with the 180 Ringing message. If the i3 PSAP receives a media feature tag of "urn:emergency:media-feature.psap-call-control" in the original INVITE and it is operating in a jurisdiction where PSAP Call Control features are supported/required, the i3 PSAP MUST assume that PSAP Call Control features are in effect end-to-end. Additionally, it SHALL be capable of receiving and processing re-INVITE messages that contain new SDP offers with attribute "a= suspended" or "a=sendrecv", indicating that the re-INVITE is associated with PSAP Call Control Features. The i3 PSAP SHALL also associate re-INVITE messages that contain both a Priority header of "emergency" and an SDP with attribute "a= inactive" or "a=sendrecv" as being associated with PSAP Call Control Features[29]. The i3 PSAP SHALL use an appropriate mechanism for notifying the PSAP attendant of the change in status[30] (as noted above, today, this notification takes the form of a switch-hook status audible tone). In response to the change in switch-hook status, the PSAP attendant may initiate a Ringback request, using the procedures described in Section A.4.1.

If an i3 PSAP is operating in a jurisdiction where PSAP Call Control features are supported/required, and it receives a SIP BYE message from an ESRP associated with a

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[27] The Media feature tag SIP framework is defined in RFC 3840 [15].

[28] See Section 10.16 of NENA-STA-010.3 [43] for values proposed for inclusion in the IANA urn:emergency:media-feature registry.

[29] The combination of Priority = "emergency" and SDP with "a=inactive" will be sent by originating networks that follow the procedures defined in PKT-SP-RSTF-C01-140314 [36] and PKT-SP-CMSS1.5-I07-120412 [37] when a caller goes on-hook and PSAP Call Control Features are in effect. (See Section A.2.). The value of the "a=" attribute within the SDP associated with these re-INVITE messages could be changed from "inactive" to "suspended" or vice-versa by SBC functionality within the ingress BCF. Note that emergency calls that originate in SIP-based networks that follow the procedures defined in PKT-SP-RSTF-C01-140314 [36] and PKT-SP-CMSS1.5-I07-120412 [37] and terminate at i3 PSAPs will not involve Legacy Selective Router Gateways.

[30] Details related to the mechanism used by the PSAP to notify the attendant of a change in caller status are outside the scope of this document.

premature disconnect, the i3 PSAP SHALL follow the procedures in RFC 3261[13] for processing the BYE message and MUST immediately notify the PSAP attendant of the change in status. In some circumstances, the i3 PSAP or call taker may initiate an immediate callback to the emergency caller. The callback initiated by the i3 PSAP SHALL follow the procedures specified in RFC 7090 [16] for marking the callback call by including a SIP Priority header value of "psap-callback" in the INVITE message associated with the callback call.

A.3.4 Procedures at the Egress Legacy Selective Router Gateway

Emergency calls that are routed via an i3 ESInet to a legacy PSAP that is served by an SR MUST traverse an egress LSRG. An egress LSRG that is operating in an environment where PSAP Call Control Features are supported MUST support the additional protocol and procedures described below.

A.3.4.1 Procedures at the Egress LSRG NIF Component

The NIF component of an egress LSRG SHALL be capable of interpreting the presence of a media feature tag of "urn:emergency:media-feature.psap-call-control" in a Contact header of the original INVITE message (and any subsequent requests in-dialog) as an indication from the originating network that it supports PSAP Call Control features. The NIF component of the egress LSRG SHALL include a media feature tag of "urn:emergency:media-feature.psap-call-control" in the Contact header of all responses (provisional and final) to that original INVITE and any subsequent requests in-dialog, beginning with the 180 Ringing or 183 Session Progress message (as appropriate based on the procedures in Section 3.1.1.3). From that point on, the NIF component of the egress LSRG MUST assume that PSAP Call Control features are in effect end-to-end.

The NIF component of the egress LSRG SHALL follow the procedures described in Section 3.2.2 with the following clarifications. If the NIF component of an egress LSRG receives a re-INVITE message from the NGCS, it SHALL forward that re-INVITE to the PIF component, including an element identifier associated with the egress LSRG in a Via header. (See Section 2.1.3 of NENA-STA-010.3 [43] for additional information on element identifiers.)

If the NIF component subsequently receives a 200 OK message from the PIF component, it SHALL pass it to the NGCS. Upon receiving an ACK from the NGCS, the NIF component SHALL forward the ACK to the PIF component.

If the NIF component receives a 180 Ringing, 183 Session Progress or INFO message from the PIF component that includes an encapsulated ISUP message with a SAP parameter containing a Feature Code Indicator set to "hold request", the NIF component SHALL send the 180 Ringing, 183 Session Progress or INFO message containing the encapsulated ISUP message and a media feature tag of "urn:emergency:media-feature.psap-call-control" in the Contact header to the NGCS.

If a NIF component receives a BYE message from an NGCS, it SHALL follow the procedures specified in RFC 3261 [13] for processing that message (i.e., it will return a 200 OK confirming receipt of the BYE message and terminating the session and the transaction,) however, before signaling the PIF component, the NIF component SHALL determine, based on provisioning, whether the PSAP supports PSAP Call Control Features. If the PSAP supports PSAP Call Control Features, the NIF component MUST generate a re-INVITE message containing an SDP with attribute "a = suspended" and send it to the PIF component, maintaining the connection to the PSAP via the legacy SR. This will allow the legacy PSAP to be notified of the change in switch-hook status of the caller and allowing it to initiate Ringback if desired.

If the NIF component receives a BYE message from the NGCS and the PSAP does not support PSAP Call Control Features, the NIF component SHALL send a BYE message to the PIF component.

If the NIF component receives a BYE message from the PIF component, it SHALL follow standard RFC 3261 [13] procedures for processing the BYE and SHALL send a BYE to the NGCS.

A.3.4.2 Procedures at the Egress LSRG PIF Component

In support of Called Party Hold, the egress LSRG PIF component SHALL follow the procedures specified in Section 3.1.1.3 for delivering the 9-1-1 call to an SR, with the following modifications. If the PIF component receives a SIP INVITE from the NIF component that includes an encapsulated IAM that contains a SAP, the PIF component SHALL generate an IAM based on the received SIP INVITE message that includes the SAP, following the procedures specified in Section 5.4.2.1 of ATIS-1000679.2015 [20].

If the egress LSRG PIF component receives a SAP parameter with a Feature Code Indicator set to "hold request" from the SR in an SS7 ACM, the LSRG PIF component SHALL encapsulate the ACM in a 180 Ringing or 183 Session Progress message, as appropriate based on the procedures in Section 3.1.1.3, and forward the 180 Ringing or 183 Session Progress message to the egress LSRG NIF.

If the egress LSRG PIF component receives a SAP parameter with a FCI set to "hold request" in an SS7 FAC message from an SR, the LSRG PIF SHALL encapsulate the FAC message in a SIP INFO message and pass it to the LSRG NIF.

In addition to the procedures specified in Section 3.1.4.2, the PIF component of the egress LSRG SHALL be capable of receiving re-INVITE messages from the NIF component. Specifically, in the context of PSAP Call Control Features, the PIF component SHALL be capable of receiving and processing a re-INVITE message that is generated as a result of the procedures specified in Section A.3.4.1.

Upon receipt of a re-INVITE message containing an SDP with attribute "a= suspended" or a re-INVITE message containing both a "Priority= emergency" header and an SDP with attribute "a= inactive" from the NIF component, the PIF component of the egress LSRG SHALL apply audio alerting to the PSAP so that the attendant is notified of the on-hook status of the emergency caller.

If the PIF component subsequently receives a re-INVITE message with a new SDP value (attribute "a= sendrecv" plus the "Priority: emergency" header), it shall stop applying the "on-hook" status alerting and re-establish the RTP to allow the conversation between the emergency caller and the attendant to resume.

If a PIF component receives an SS7 REL from a legacy SR, the PIF component SHALL send a BYE message to the NIF component. If the PIF component receives a BYE message from the NIF component, it SHALL apply standard RFC 3261 [13] procedures for processing the BYE message and send an SS7 REL to the legacy SR.

A.4 Ringback

The Ringback feature enables the PSAP attendant to invite back an emergency caller, or someone in the caller's surrounding area, into the conversation, over an established connection. This feature has different behaviors depending on the state of the device ("on-hook" or "off-hook"). If a conversation between an emergency caller and a PSAP attendant is occurring but the emergency caller stops responding, the Ringback feature allows the attendant to request that the receiver off-hook tone (also known as "howler tone") be temporarily played at the caller's device. As a complement to the Called Party Hold feature, the Ringback feature also allows the attendant to request that the emergency caller's device ring, if it has gone "on-hook".

A.4.1 Procedures at the PSAP

If an emergency call has been established, Called Party Hold is active on that call, and the emergency caller disconnects prematurely from the call, the PSAP may wish to re-invite the caller to the call by initiating a Ringback toward that caller to trigger normal ringing of the caller's device. Likewise, if Called Party Hold is active on an existing emergency call but conversation with the emergency call has ceased abruptly, the PSAP may attempt to re-invite the emergency caller or someone else in the area to re-establish communication by initiating a ringback toward that caller to trigger the application of "howler tone".

In the case of a legacy PSAP, the attendant will typically trigger the Ringback by sending a switch-hook flash then dialing the Ringback access code (e.g., "*99"), resulting in DTMF signaling being sent to the SR. The SR will then generate an SS7 FAC message that contains a SAP with a value of "ringback request" toward the egress LSRG.

In the case of an i3 PSAP, it is expected that, in response to an action taken by the attendant to request Ringback, the Ringback feature will be triggered by the PSAP UA issuing a re-INVITE with an Alert-Info header[31] set to the appropriate audible ringing tone URI (typically, regular ringing, if the caller is considered "on-hook," or ROH/howler tone, if the caller is considered "off-hook") towards the emergency caller.

Note that if an i3 PSAP receives a BYE associated with an emergency call or a legacy PSAP receives an on-hook indication from a legacy SR (i.e., Called Party Hold is not active on the call), and the PSAP wishes to re-establish contact with the emergency caller, the PSAP MAY initiate a callback to that emergency caller. If the callback is initiated by an i3 PSAP, the i3 PSAP SHALL follow the procedures specified in RFC 7090 [16] for marking the callback call by including a SIP Priority header value of "psap-callback" in the INVITE message associated with the callback call.

A.4.2 Procedures at the Egress Legacy Selective Router Gateway

A.4.2.1 Procedures at the Egress LSRG PIF Component

Upon receiving a Ringback request from a legacy SR (in the form of a SS7 FAC message with SAP set to "ringback request"), the PIF component SHALL generate a SIP INFO message that includes an encapsulated SS7 FAC message with a SAP that contains a Feature Code Indicator set to "ringback request", and pass it to the NIF component (see Table 9B/T1.113.3 of GR-246-CORE [19] for details regarding the coding of the SS7 FAC message).

If the PIF component subsequently receives a 183 Session Progress message or 180 Ringing message from the NIF component (associated with an on-hook or off-hook ringback request, as described in Section A.4.2.2) in response, it will apply audible ringing on the existing media path to the legacy PSAP.

A.4.2.2 Procedures at the LSRG-NIF Component

If the NIF component receives an INFO message from the PIF component containing an SS7 FAC with SAP set to "ringback request" and the NIF component determines that Called Party Hold is active on the call, the NIF component SHALL generate a re-INVITE message

[31] Some deployments may use the P-DCS-OSPS header with a value of "RING" as defined in RFC 5503 [41] to signal Ringback. The specific method being used in one jurisdiction is determined through bilateral negotiations.

toward the emergency caller. The re-INVITE message MUST contain an Alert-Info header that indicates the type of alerting that should be provided. If the SDP currently associated with the call is "suspended" or "inactive" (i.e., the latest re-INVITE received by the NIF component contained an SDP with attribute "a= suspended" or an SDP attribute "a= inactive" with "Priority = emergency"), the ringing tone URI included in the Alert-Info header SHALL be associated with regular ringing. If the SDP associated with the call has been updated in the most recently received re-INVITE message (i.e., SDP with attribute "a= sendrecv" with the "Priority: emergency" header), the ringing tone URI in the Alert-Info header will be associated with a receiver off-hook/howler tone to be played for a defined period.

If the Alert-Info header sent by the NIF in the re-INVITE message is associated with regular ringing (i.e., because the caller has gone "on-hook"), the NIF component SHALL be capable of receiving and processing a 183 Session Progress message or 180 Ringing message in response, indicating that the emergency caller is being alerted. The NIF component SHALL pass the 183 Session Progress/180 Ringing message to the PIF component.

If the NIF component subsequently receives a 200 OK in response to the re-INVITE message it generated, the voice path SHALL be re-established between the emergency caller and the PSAP.

If the NIF component receives an INFO message from the PIF component containing an SS7 FAC with SAP set to "ringback request" requesting initiation of the Ringback feature and the connection between the egress LSRG and the emergency caller no longer exists (because the NIF component previously received a BYE or CANCEL from the NGCS associated with the emergency call), the NIF component SHALL initiate a callback request to/towards that caller. The callback initiated by the NIF component of the egress LSRG SHALL follow the procedures specified in RFC 7090 [16] for marking the callback call by including a SIP Priority header value of "psap-callback" in the INVITE message associated with the callback call.

A.4.3 Procedures at the ESRP

If the ESRP is stateful (i.e., has been identified in record routing), and is therefore in the path of the re-INVITE messages, the ESRP SHALL follow normal procedures, as described in RFC 3261 [13], for passing SIP re-INVITE messages and associated responses (200 OK and ACK).

A.4.4 Procedures at the Ingress Legacy Selective Router Gateway

A.4.4.1 Procedures at the Ingress LSRG-NIF Component

The NIF component of the ingress LSRG SHALL be capable of receiving and processing a re-INVITE message that contains an Alert-Info header. If the NIF component receives a re-INVITE message containing an Alert-Info header associated with an emergency call that was delivered over an SS7 trunk group, the NIF component SHALL generate a SIP INFO message that includes an encapsulated SS7 FAC message with a SAP that contains a Feature Code Indicator set to "ringback request", and pass it to the PIF component (see Table 9B/T1.113.3 of GR-246-CORE [19] for details regarding the coding of the SS7 FAC message).

If the NIF component receives a re-INVITE message containing an Alert-Info header associated with an emergency call that was delivered over an MF trunk group, the NIF component SHALL forward the re-INVITE message to the PIF component.

A.4.4.2 Procedures at the Ingress LSRG-PIF Component

As described in Section A.3.1.1.2, the PIF component of the ingress LSRG SHALL be capable of receiving and processing a SIP INFO message from the NIF component. If the PIF component receives a SIP INFO containing an encapsulated FAC message from the NIF component, the PIF component SHALL generate an SS7 FAC message based on the encapsulated FAC message. In this scenario, a 180 Ringing Message SHOULD NOT be generated by the PIF component towards the NIF.

If the PIF component receives a re-INVITE message containing an Alert-Info header, the PIF component SHALL apply alerting toward the caller appropriate for the audible ringing tone URI provided in the Alert-Info header and SHALL return a SIP 180 Ringing message to the NIF component.

A.5 Enhanced Called Party Hold

As a complement to the Called Party Hold feature, Enhanced Called Party Hold allows the media path to be established even though the PSAP attendant hasn't yet answered when the caller hangs up. Once the attendant picks up, regular connection hold capabilities apply. Therefore, if the caller picks up again, his/her conversation with the attendant will automatically resume.

If a legacy originating network supports Enhanced Called Party Hold, an ECPH timer will be supported at the SR. The external signaling generated by the origination network and by the SR is expected to be the same as for Called Party Hold (see Sections A.3.1.1and A.3.1.1.1for scenarios where the originating switch connects to the SR via an SS7 trunk group and Section A.3.1.2 for scenarios where the originating switch connects to the SR via an MF trunk group) with the following clarifications. If the caller disconnects before the PSAP answers the call and the ECPH timer is still active, the connection between the SR and the caller is maintained. If an SS7 ANM is received from the ingress LSRG PIF before the ECPH timer has expired, the SR will cancel the timer and generate an SS7 FAC message with a Feature Code Indicator in the SAP set to "disconnect request" and send it to the ingress LSRG PIF. The LSRG PIF and NIF will then follow the procedures specified in Sections A.3.1.1.2 and A.3.1.1.3 for Called Party Hold.

If the ECPH timer expires before an SS7 ANM is received by the SR, the SR will generate an on-hook signal toward the originating switch (if the connection to the originating switch is an MF trunk) or SS7 REL message toward the originating switch if the connection to the originating switch is an SS7 trunk) as well as an SS7 REL toward the ingress LSRG PIF. If the ingress LSRG PIF receives an SS7 REL from the SR prior to receipt of a 200 OK from the ingress LSRG NIF, the ingress LSRG PIF will return an SS7 RLC to the SR and will send a CANCEL message to the ingress LSRG NIF.

The Called Party Hold procedures applicable to the ESRP, i3 PSAP and egress LSRG, as described in Sections A.3.2, A.3.3, and A.3.4, respectively, SHALL also apply for Enhanced Called Party Hold.

Note that if a VoIP originating network does not support feature-specific signaling associated with PSAP Call Control Features and the caller disconnects before the PSAP attendant answers the call, a SIP CANCEL MAY be sent by the originating network. The CANCEL message SHALL be processed as specified in RFC 3261 [13] by all elements in the call path. As described in Section 4.2.1.9 of NENA-STA-010.3 [43], if a call arrives at the ESRP but a CANCEL is received prior to any response message being received from an i3 PSAP (or LPG or egress LSRG), such that the ESRP is unsure as to whether or not the INVITE message was ever received by the PSAP, the ESRP MUST notify the PSAP (or LPG or egress LSRG) using the AbandonedCall event.

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