



ATIS-0500036

ATIS Standard on -

**ATIS Standard for IMS-based Next Generation Emergency
Services Network Interconnection**



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ATIS Standard for IMS-based Next Generation Emergency Services Network Interconnection

Alliance for Telecommunications Industry Solutions

Approved July 2018

Abstract

This Standard defines the Stage 2 (architecture) and Stage 3 (protocol) specifications for the interconnection of an IMS-based NG9-1-1 Emergency Services Network with legacy and other Next Generation NG9-1-1 Emergency Services Networks for initial emergency call origination and call transfers (bridging). This Standard is incremental to ATIS-0500032, *ATIS Standard for Implementation of an IMS-based NG9-1-1 Service Architecture*, in that it focuses on the interactions between the IMS-based NG9-1-1 Emergency Services Networks and other emergency services networks. ATIS-0500032 includes the architecture, functional elements, call flows, protocols and interfaces which were derived from the Stage 1 requirements in ATIS-0500023, *Applying Common IMS to NG9-1-1 Networks*. This Standard expands upon those principles to specify interactions between emergency services networks.

Foreword

The Alliance for Telecommunication Industry Solutions (ATIS) serves the public through improved understanding between carriers, customers, and manufacturers.

The ESIF IP Multimedia Subsystem for 9-1-1 (IMS911) subgroup led the development of this document. This is a joint effort with the Emergency Services Interconnection Forum Next Generation Emergency Service (ESIF NGES) Subcommittee, Packet Technologies and Systems Committee (PTSC), and the Wireless Technologies and Systems Committee Systems and Network Subcommittee (WTSC SN).

The Emergency Services Interconnection Forum (ESIF) provides a forum to facilitate the identification and resolution of technical and/or operational issues related to the interconnection of wireline, wireless, cable, satellites, Internet, and emergency services networks.

The ESIF Next Generation Emergency Services (NGES) Subcommittee coordinates emergency services needs and issues with and among SDOs and industry forum/committees, within and outside ATIS, and develops emergency services (such as E9-1-1) standards, and other documentation related to advanced (i.e., Next Generation) emergency services architectures, functions, and interfaces for communications networks.

The Packet Technologies and Systems Committees (PTSC) develops and recommends standards and technical reports related to services, architectures, and signaling, in addition to related subjects under consideration in other North American and international standards bodies. PTSC coordinates and develops standards and technical reports relevant to telecommunications networks in the U.S., reviews and prepares contributions on such matters for submission to U.S. ITU-T and U.S. ITU-R Study Groups or other standards organization, and reviews for acceptability or per contra the positions of other countries in related standards developments and takes or recommends appropriate actions.

The Wireless Technologies and Systems Committee (WTSC) develops and recommends standards and technical reports related to wireless and/or mobile services and systems, including service descriptions and wireless technologies. WTSC develops and recommends positions on related subjects under consideration in other North American, regional, and international standards bodies.

The WTSC Systems and Networks Subcommittee (WTSC SN) develops, maintains, amends, and enhances American National Standards and ATIS deliverables related to systems aspects, networks, and terminals within the GSM family (GSM/EGPRS/UMTS) such as circuit-switched, packet-switched, and IP Multimedia services including future developments.

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

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Preface

ATIS has developed a Next Generation 9-1-1 network and emergency call processing architecture based on contributions received since 2011 and based on requirements by a number of wireless carriers to have an IP Multimedia Subsystem (IMS)-compatible NG9-1-1 design¹. Additionally, the NENA i3 Architecture Working Group² deferred the IMS-based Emergency Services IP network (ESInet) development to ATIS. ATIS' goal in developing this standard has been transparent interoperability between the two network designs.

ATIS' intent in this development work was to produce a standard method for IMS-based carriers to offer NG9-1-1 services wholly within their IMS platforms, while maintaining consistency and interoperability with the NENA i3 ESInet/NGCS (Next Generation Core Services) design goals. This kind of standards approach allows IMS-based carriers to take advantage of complete IMS interoperability and features found in their existing IMS ecosystems, while remaining interoperable with downstream i3 PSAPs that implement NENA i3 standards and interfaces.

It is also ATIS' goal to assure that terminating NG9-1-1 entities, such as i3 PSAPs, find the upstream networks that are built on the ATIS IMS-based NG9-1-1 Service Architecture to be as completely interoperable with their systems and networks as that of a NENA i3 NG9-1-1 standard SIP-based architecture. This goal of transparency, both upstream and downstream between architectures, ensures that an i3 PSAP should find no difference whether the i3 PSAP interconnects to a NENA i3 ESInet with NGCS, or interconnects to an ATIS IMS-based NG9-1-1 Service Architecture. This consistent interoperability principle has guided all of ATIS' development work since the beginning, as documented within the original Issue Statement underlying this work.

The ATIS IMS-based NG9-1-1 Service Architecture provides compatibility for IMS-based carriers acting as an NG9-1-1 System Service Provider (NG911SSP) to seamlessly interoperate with NENA i3 ESInet architectures.

For entities early in the process of selecting ESInet solutions, the expectation within this ATIS development work was that the ATIS IMS-based NG9-1-1 Service Architecture would offer a choice for carriers that already had an IMS ecosystem, but not be considered a viable architecture choice for 9-1-1 service entities that had no plans for an IMS infrastructure.

Public Safety entities should naturally understand the applicability of an IMS-based NG9-1-1 Service Architecture network approach to processing emergency calls, yet in this case, they can remain confidently focused on NENA i3-based NG9-1-1 architectures, (this is because IMS may be of interest to carriers, not to jurisdictions), which means that Public Safety's progress and momentum to adopt NG9-1-1 will not be impeded by the introduction of this ATIS NG9-1-1 Service Architecture standard.

1 Scope, Purpose, & Application

1.1 Scope

The scope of this Standard is to specify the inter-Emergency Services Network interactions for initial emergency calls that are required to be routed to another Emergency Service Network and calls that may be transferred (bridged) between Emergency Services Networks. This Standard is incremental to ATIS-0500032 in that it focuses

¹ IMS is a set of standards based on the IETF RFC 3261 [Ref 14] family of standards that also introduces additional requirements, specific for carrier operators not differentiated in the more general SIP RFCs.

² The NENA i3 Architecture Working Group developed NENA-STA-010.2 [Ref 23].

on the interactions between those networks. This Standard defines the Stage 2 (architecture) and Stage 3 (protocol) specifications to support the interconnection between Emergency Services Networks.

1.2 Purpose

IMS standards for Emergency Services have been under development and enhancement in 3GPP since 3GPP Release 9. However, from a Next Generation Emergency Services (NG9-1-1) network perspective, the IMS architecture only defined Emergency Service call processing for the originating network and has not specified the application of IMS architecture concepts to NG9-1-1 Emergency Services Networks or the interconnection of IMS-based NG9-1-1 Emergency Services Networks with legacy and other Next Generation NG9-1-1 Emergency Services Networks.

The purpose of this Standard is to define the Stage 2 (architecture) and Stage 3 (protocols) to enable the interconnection of North American IMS-based NG9-1-1 emergency services networks with other legacy and Next Generation Emergency Services Networks deployed in North America to support the delivery of initial and transferred emergency calls.

1.3 Application

This standard applies to initial requests for emergency services and transfers that require interactions between an IMS-based Next Generation Emergency Services Network and legacy and other Next Generation Emergency Services Networks. This standard applies to routing voice, text, and multimedia requests.

2 Normative References

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

[Ref 1] 3GPP TS 23.167, *Technical Specification Group Services and System Aspects; IP Multimedia Subsystem (IMS) emergency sessions*.³

[Ref 2] 3GPP TS 24.229, *Technical Specification Group Services and System Aspects; IP multimedia call control protocol based on Session Initiation Protocol (SIP) and Session Description Protocol (SDP); Stage 3*.³

[Ref 3] 3GPP TS 22.101, *Technical Specification Group Services and System Aspects; Service aspects; Service principles*.³

[Ref 4] 3GPP TS 23.002, *Technical Specification Group Services and System Aspects; Network architecture*.³

[Ref 5] 3GPP TS 23.271, *Technical Specification Group Services and System Aspects; Functional Stage 2 description of Location Services (LCS)*.³

[Ref 6] IETF RFC 5222, *LoST: A Location-to-Service Translation Protocol*.⁴

[Ref 7] J-STD-036-C, *Enhanced Wireless 9-1-1 Phase II*, June 2011 including the addendum in J-STD-036-C-2, *Addendum to J-STD-036-C, Enhanced Wireless 9-1-1 Phase II*.⁵

[Ref 8] IETF RFC 6753, *A Location Dereferencing Protocol Using HELD*.⁴

[Ref 9] 3GPP TS 24.147, *Technical Specification Group Core Network and Terminals; Conferencing using the IP Multimedia (IM) Core Network (CN) subsystem; Stage 3*.³

³ This document is available from the Third Generation Partnership Project (3GPP) at: < <http://www.3gpp.org/> >.

⁴ This document is available from the Internet Engineering Task Force (IETF) at: < <http://www.ietf.org> >.

⁵ This document is available from the Alliance for Telecommunications Industry Solutions (ATIS), 1200 G Street N.W., Suite 500, Washington, DC 20005 at: < <https://www.atis.org/docstore/default.aspx> >.

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- [Ref 10] IETF 4353, *A Framework for Conferencing with the Session Initiation Protocol (SIP)*.⁴
- [Ref 11] ATIS-1000679.2015, *Interworking between Session Initiation Protocol (SIP) and Bearer Independent Call Control or ISDN User Part*.⁵
- [Ref 12] IETF RFC 6442, *Location Conveyance for the Session Initiation Protocol*.⁴
- [Ref 13] IETF RFC 3265, *Session Initiation Protocol (SIP) – Specific Event Notification*.⁴
- [Ref 14] IETF RFC 3261, *SIP: Session Initiation Protocol*.⁴
- [Ref 15] 3GPP TS 23.228, *Technical Specification Group Services and System Aspects; IP Multimedia Subsystem (IMS); Stage 2*.³
- [Ref 16] IETF RFC 4112, *Communications Resource Priority for the Session Initiation Protocol (SIP)*.⁴
- [Ref 17] IETF RFC 7134, *The Management Policy of the Resource Priority Header (RPH) Registry Changed to "IETF Review"*.⁴
- [Ref 18] IETF RFC 4579, *Session Initiation Protocol (SIP) Call Control - Conferencing for User Agents*.⁴
- [Ref 19] IETF RFC 7044, *An Extension to the Session Initiation Protocol (SIP) for Request History Information*.⁴
- [Ref 20] IETF RFC 3455, *Private Header (P-Header) Extensions to the Session Initiation Protocol (SIP) for the 3rd-Generation Partnership Project (3GPP)*.⁴
- [Ref 21] IETF RFC 3325, *Private Extensions to the Session Initiation Protocol (SIP) for Asserted Identity within Trusted Networks*.⁴
- [Ref 22] ATIS-0500023, *Applying Common IMS to NG9-1-1 Networks*.⁵
- [Ref 23] NENA-STA-010.2, *Detailed Functional and Interface Standards for the NENA i3 Solution*.⁶
- [Ref 24] IETF RFC 2616, *Hypertext Transfer Protocol -- HTTP/1.1*.⁴
- [Ref 25] 3GPP TS 29.333, *Technical Specification Group Core Network and Terminals; Multimedia Resource Function Controller (MRFC) - Multimedia Resource Function Processor (MRFP) Mp interface: Procedures Descriptions*.³
- [Ref 26] ATIS-0500032, *ATIS Standard for Implementation of a 3GPP IMS-based NG9-1-1 Emergency Services Network*.⁵
- [Ref 27] NENA-STA-010.3, *Detailed Functional and Interface Standards for the NENA i3 Solution*, pending publication.⁷

3 Informative References

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

- [Ref 101] NENA-ADM-000.21.1-2018, *NENA Master Glossary of 9-1-1 Terminology*.⁶
- [Ref 102] NENA 03-003 *NENA Recommendation for Implementation of Inter-Networking, E9-1-1 Tandem to Tandem*, February 1, 2000.⁶
- [Ref 103] NENA-INF-008.1 *NENA NG9-1-1 Transition Plan Information Document*.⁶

⁶ This document is available from the National Emergency Number Association at:
<<https://www.nena.org/>>.

⁷ This document will be available upon publication from the National Emergency Number Association at:
<<https://www.nena.org/>>.

4 Definitions, Acronyms, & Abbreviations

4.1 Definitions

E.164 Number	E.164 is an international numbering plan for public telephone systems in which each assigned number contains a country code (CC), a national destination code (NDC), and a subscriber number (SN). There can be up to 15 digits in an E.164 number. The E.164 plan was originally developed by the International Telecommunication Union (ITU).
Emergency Call Routing Function (ECRF) ⁸	A functional element in an ESInet that is a LoST protocol server where location information (either civic address or geo-coordinates) and a Service URN serve as input to a mapping function that returns a URI used to route an emergency call toward the appropriate PSAP for the caller's location or towards a responder agency. ⁸
Emergency Services IP network (ESInet) ⁹	A managed IP network that is used for emergency services communications, and that can be shared by all public safety agencies. It provides the IP transport infrastructure upon which independent application platforms and core functional processes can be deployed, including, but not restricted to, those necessary for providing NG9-1-1 services. ESInets may be constructed from a mix of dedicated and shared facilities. ESInets may be interconnected at local, regional, state, federal, national, and international levels to form an IP-based inter-network (network of networks).
IMS-based NG9-1-1 Service Architecture	An IMS-based NG9-1-1 Service Architecture provides transit, routing, and other services required to support citizen-to-authority multimedia emergency services between the originating network and the emergency authority, e.g., PSAP. The IMS-based NG9-1-1 Service Architecture includes the i3 Legacy Network Gateway and i3 Legacy PSAP Gateway.
Legacy Network Gateway (LNG) ⁹	A signaling and media interconnection point between callers in legacy wireline/wireless originating networks and the IMS-based NG9-1-1 Emergency Services Network. This Functional Element provides MF/SS7-to-SIP signaling interworking, as well as emergency services-specific processing of legacy emergency originations and location acquisition/dereferencing functionality.
Legacy PSAP Gateway (LPG) ⁹	A signaling and media interconnection point between the IMS-based NG9-1-1 Emergency Services Network and legacy PSAPs. This Functional Element provides SIP-to-Traditional/Enhanced MF signaling interworking as well as emergency services-specific processing to support: the delivery of emergency originations to legacy PSAPs; emergency call transfers involving legacy PSAPs; ALI queries from legacy PSAPs; and location and additional data dereferencing functionality.
Location by Reference (LbyR)	Location by Reference refers to the option to deliver a location reference URI in a header of the call request (SIP INVITE) that may be used by the requesting entity (e.g., the PSAP) to query for the location of the caller.
Location by Value (LbyV)	Location by Value refers to the option to deliver the caller's location to the PSAP within the body of the call request (SIP INVITE).
NG9-1-1 ¹⁰	An IP-based system comprised of managed IP-based networks (ESInets), functional elements (applications), and databases that replicate traditional E9-1-1 features and functions and provide additional capabilities. NG9-1-1 is designed to provide access to emergency services from all connected communications sources and provide multimedia data capabilities for PSAPs and other emergency service organizations. ⁹

⁸ Refer to NENA-ADM-000.21.1-2018, NENA Master Glossary of 9-1-1 Terminology [Ref 101].

⁹ Refer to NENA i3/NG9-1-1 [Ref 23].

¹⁰ The term "NG911" used throughout this document is synonymous with the term "NG9-1-1".

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pANI (Pseudo Automatic Number Identification)	A telephone number used to support routing of wireless 9-1-1 calls. It may identify a wireless cell, cell sector, or PSAP to which the call should be routed. Also known as routing number.
Policy Store	A functional element in the ESInet that stores policy documents.
Reference Identifier	The term "Reference Identifier" is used in this standard to associate the call with location information of the caller. For routing to a legacy emergency services network, a Reference Identifier may be an Emergency Services Routing Key (ESRK) or Emergency Services Routing Digit (ESRD) as defined in J-STD-036-C [Ref 7]. It may be the Telephone Number that is used by the legacy emergency services network to query for location information. In a legacy emergency services network, the Reference Identifier may also be used by the emergency services network to route the call to the PSAP. For calls routed to a NENA i3 ESInet, the Reference Identifier may be a dereferencing URI that is used by i3 functional elements and i3 PSAPs to obtain location. ¹¹

4.2 Acronyms & Abbreviations

3GPP	Third Generation Partner Program
ADR	Additional Data Repository
ALI	Automatic Location Identification
ANI	Automatic Number Identification
ANM	SS7 Answer Message
AS	Application Server
ATIS	Alliance for Telecommunications Industry Solutions
B2BUA	Back-to-Back User Agent
BCF	Border Control Function
BGCF	Breakout Gateway Control Function
CAMA	Centralized Automatic Message Accounting
cid	Content-ID
CgPN	Calling Party Number
CSeq	Command Sequence
DNS	Domain Name Server
DTMF	Dual Tone Multi-Frequency
E-CSCF	Emergency Call Session Control Function
ECRF	Emergency Call Routing Function (NENA i3)
EIDD	Emergency Incident Data Document
E-MF	Enhanced Multi Frequency
ESIF	Emergency Services Interconnection Forum
ESInet	Emergency Services IP network
ESN	Emergency Service Number
ESQK	Emergency Services Query Key
ESRD	Emergency Services Routing Digits
ESRK	Emergency Services Routing Key

¹¹ Use of an Emergency Services Query Key (ESQK) as a Reference Identifier is for further study, pending the definition of use cases and call flows that illustrate the circumstances under which an ESQK applies.

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ESRP	Emergency Service Routing Proxy
GIS	Geographic Information System
GMLC	Global Mobile Location Center
HELD	HTTP-Enabled Location Delivery
HTTP	Hypertext Transfer Protocol
HTTPS	HTTP Secure
IAM	Initial Address Message
IBCF	Interconnection Border Control Function
I-CSCF	Interrogating Call Session Control Function
IMS	IP Multimedia Subsystem
IP	Internet Protocol
ISDN	Integrated Services Digital Network
ISUP	ISDN User Part
ITU	International Telecommunication Union
LBR	Location Based Routing
LbyR	Location by Reference
LbyV	Location by Value
LIS	Location Information Server
LNG	Legacy Network Gateway
LoST	Location to Service Translation Protocol
LPG	Legacy PSAP Gateway
LRF	Location Retrieval Function
LS	Location Server
LSRG	Legacy Selective Router Gateway
MF	Multi Frequency
MGCF	Media Gateway Control Function
MLP	Mobile Location Position
MPC	Mobile Positioning Center
MRFC	Media Resource Function Controller
MRFP	Media Resource Function Processor
MSC	Mobile Switching Center
NANP	North American Numbering Plan
NENA	National Emergency Number Association
NG	Next Generation
NGCS	Next Generation Core Services
OSP	Originating Service Provider
PAI	P-Asserted-Identity
pANI	pseudo Automatic Number Identification
P-CSCF	Proxy-Call Session Control Function
PTSC	Packet Technologies and Systems Committee
PIDF-LO	Presence Information Data Format – Location Object
PRF	Policy Routing Function
PSAP	Public Safety Answering Point
RDF	Routing Determination Function
SBC	Session Border Controller

S-CSCF	Serving-Call Session Control Function
SDP	Session Description Protocol
SIP	Session Initiation Protocol
SR	Selective Router
SRDB	Selective Routing Database
SS7	Signaling System Number 7
TCP	Transmission Control Protocol
TLS	Transport Layer Security
TN	Telephone Number
TRF	Transit Function
UDP	User Datagram Protocol
URI	Uniform Resource Identifier
URN	Uniform Resource Name
VoIP	Voice over IP
VPN	Virtual Private Network
WTSC	Wireless Technologies and Systems Committee

5 Introduction

The emergency services landscape within North America provides a greater level of detail than has been specified by 3GPP. Specifically, 3GPP only defined emergency procedures in originating networks and did not explicitly develop requirements for emergency services networks.

This standard provides additional details to the 3GPP IMS specifications to support the application of IMS in emergency services networks within North America. This specification focuses on the interactions between an IMS-based Next Generation (NG) Emergency Services Network and legacy and other Next Generation NG9-1-1 Emergency Services Networks for initial emergency services requests and transfers. This standard uses 3GPP IMS standards as its base and considers how the specific aspects of the 3GPP IMS standards apply within the context of the North American emergency services network interconnection architecture. This standard is incremental to ATIS-0500032 in that it focuses on inter-Emergency Services Network interactions.

This standard supports all classes of service and media types and is not limited to voice.

6 Assumptions & Requirements

6.1 Basic Assumptions

Assumptions used to develop this standard extend those defined in the Stage 1 document ATIS-0500023 [Ref 22] to support interworking between Emergency Services Networks and include modifications to reflect the evolution of the IMS-based NG9-1-1 Service Architecture.

1. The ATIS IMS-based NG9-1-1 Service Architecture supports sending, receiving, and transferring calls to/from NENA i3-compliant ESNets, to/from other ATIS IMS-based NG9-1-1 Emergency Services Networks, and to/from legacy Emergency Services Networks.
2. Based upon routing criteria, initial calls ingressing to the Upstream IMS-based NG9-1-1 Service Architecture network from Originating Service Provider (OSP) networks may have to be delivered to a PSAP served by another Emergency Services Network.
3. Initial calls ingressing from OSP networks that use NENA i3 compliant interfaces and that are forwarded to another Emergency Services Network may include Location-by-Value (LbyV) or Location-by-Reference (LbyR).

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4. If initial calls are received by the Downstream NG9-1-1 Emergency Services Network with LbyR, then the Downstream NG9-1-1 Emergency Services Network will have to dereference the location reference to retrieve the routing location (by value) in order to route the call.
5. If initial calls are received by an Upstream NG9-1-1 Emergency Services Network with LbyR and are sent to a legacy Emergency Services Network, the gateway in the Downstream Legacy Emergency Services Network will interwork the dereference location information into legacy formats.
6. If initial calls are received by an Upstream Legacy Emergency Services Network, the gateway will interwork the signaling and location information into NG9-1-1 formats.
7. Calls transferred to/from an IMS-based NG9-1-1 Service Architecture from/to a NENA i3-compliant ESNet or other IMS-based NG9-1-1 Service Architecture network will include a reference to the Emergency Incident Data Document (EIDD). This must be dereferenced by the PSAP or Legacy PSAP Gateway (LPG) in order to obtain location and additional data.
8. For calls transferred from an IMS-based NG9-1-1 Service Architecture to a legacy Emergency Services Network the gateway will use the content of the EIDD to populate the legacy signaling.
9. For calls transferred to an IMS-based NG9-1-1 Service Architecture from a legacy Emergency Services Network the gateway will create an EIDD and a reference to it.
10. Calls delivered to legacy PSAPs served by the Downstream NG9-1-1 Emergency Services Network will include either the calling number/Automatic Number Identification (ANI) or a pseudo ANI (pANI), and in some cases a callback number. The legacy PSAP will have to query the LPG between the Downstream NG9-1-1 Emergency Services Network and the legacy PSAP to retrieve the location and, if not previously received, the callback number.
11. Initial calls from mobile OSP networks should be delivered along with LbyR to the Upstream IMS-based NG9-1-1 Service Architecture. If the call is delivered to a Downstream IMS-based NG9-1-1 Emergency Services Network, the Location Retrieval Function (LRF) in the Downstream IMS-based NG9-1-1 Emergency Services Network shall be able to dereference the LbyR to retrieve a routing location (by value). The dereference request may follow different paths depending on where the LbyR was generated.
 - a. If the LbyR received by the Downstream IMS-based NG9-1-1 Emergency Services Network was generated by an LRF in an IMS-based originating network, the LRF in the Downstream IMS-based NG9-1-1 Emergency Services Network will query the LRF in the originating network to retrieve the routing location (by value).
 - b. If the LbyR received by the Downstream IMS-based NG9-1-1 Emergency Services Network was generated by a LIS/LS in a VoIP access network, the LRF in the Downstream IMS-based NG9-1-1 Emergency Services Network will query the LIS/LS in the VoIP access network to retrieve the routing location (by value).
 - c. If the originating network is a legacy wireless network, then gateway functionality within the Upstream IMS-based NG9-1-1 Service Architecture Legacy Network Gateway (LNG) will be responsible for generating the LbyR that is delivered to the Downstream IMS-based NG9-1-1 Emergency Services Network. In this scenario, the LRF in the Downstream IMS-based NG9-1-1 Emergency Services Network will query the LNG, and the LNG will be responsible for interacting with a Mobile Positioning Center/ Gateway Mobile Location Center (MPC/GMLC) in the legacy wireless originating network.
12. The IMS-based NG9-1-1 Emergency Services Network described in this specification will replicate the functionality provided by a NENA i3 ESNet and associated functional elements. Any differences in the way that functionality is distributed among the elements of the IMS-based NG9-1-1 Emergency Services Network when compared to the NENA i3 solution architecture will be transparent to the PSAPs and originating networks served by the IMS-based NG9-1-1 Emergency Services Network.

6.2 Requirements

The following clauses provide requirements for Emergency Services Network interconnection. They are separated into requirements for initial calls, requirements for bridged calls and common requirements.

6.2.1 Requirements for Initial Calls Sent to a Downstream Emergency Services Network

1. The Downstream NG9-1-1 Emergency Services Network must support procedures to prevent looping of emergency calls.
 - a. Clarification: If a call is presented to the Downstream NG9-1-1 Emergency Services Network, it must not return that call to the Upstream NG9-1-1 Emergency Services Network which may result in looping calls.
2. The Upstream NG9-1-1 Emergency Services Network may use Location Based Routing (LBR) or alternate routing to determine that a call must be presented to the Downstream NG9-1-1 Emergency Services Network.
3. The Upstream NG9-1-1 Emergency Services Network must provide location or a reference to it by using the Geolocation header.
4. The Upstream NG9-1-1 Emergency Services Network may provide additional data or a reference to it by using the Call-Info header.
5. The Upstream NG9-1-1 Emergency Services Network may provide a History-Info header indicating the reason that the call has been sent to a Downstream NG9-1-1 Emergency Services Network.
6. The Upstream NG9-1-1 Emergency Services Network must provide the NENA Call ID.
7. The Upstream NG9-1-1 Emergency Services Network must provide the NENA Incident ID.

6.2.2 Requirements for Bridged Calls Sent to a Downstream Emergency Services Network

1. The Upstream NG9-1-1 Emergency Services Network must provide a reference to the EIDD by using the Call-Info header.
2. The Upstream NG9-1-1 Emergency Services Network must provide the identity of the transferred-to PSAP in the call signaling.
 - a. Clarification: It is expected that the Downstream NG9-1-1 Emergency Services Network will use destination routing to deliver the call to the PSAP.
3. The Upstream NG9-1-1 Emergency Services Network must provide a History-Info header indicating the reason that the call has been sent to a Downstream NG9-1-1 Emergency Services Network.
4. The Upstream NG9-1-1 Emergency Services Network must provide a notification procedure to notify entities in the Downstream NG9-1-1 Emergency Services Network of bridging activity (e.g. adding or dropping participants).

6.2.3 Common Requirements

1. Session initiation (call) signaling for IP connected emergency call shall be SIP based.
2. SIP signaling between the networks must be Transmission Control Protocol (TCP) with TLS. Fallback to TCP/UDP without Transport Layer Security (TLS) is allowed.
3. The network interconnection may be via VPN or direct connect based upon bilateral agreements.
4. Downstream NG9-1-1 Emergency Services Networks must accept IPv4 and IPv6, with the Session Border Controller (SBC) component of the Border Control Function (BCF) providing translation from IPv4 to IPv6 if necessary
5. NG9-1-1 Emergency Services Networks must support the use of Domain Name Server (DNS). It is preferred that elements of an NG9-1-1 Emergency Services network be referred to by their hostname using DNS rather than by their IP address.
6. The network interconnection must support all media types in all combinations.
7. The network interconnection must support the ability to add or delete media during a call.

8. Each NG9-1-1 Emergency Services Network must provide congestion controls.
9. Each service provider must inform the other of planned outages or maintenance.

7 Architecture

7.1 Overview

Figure 7.1 illustrates the ATIS IMS-based NG9-1-1 Service Architecture described in ATIS-0500032.

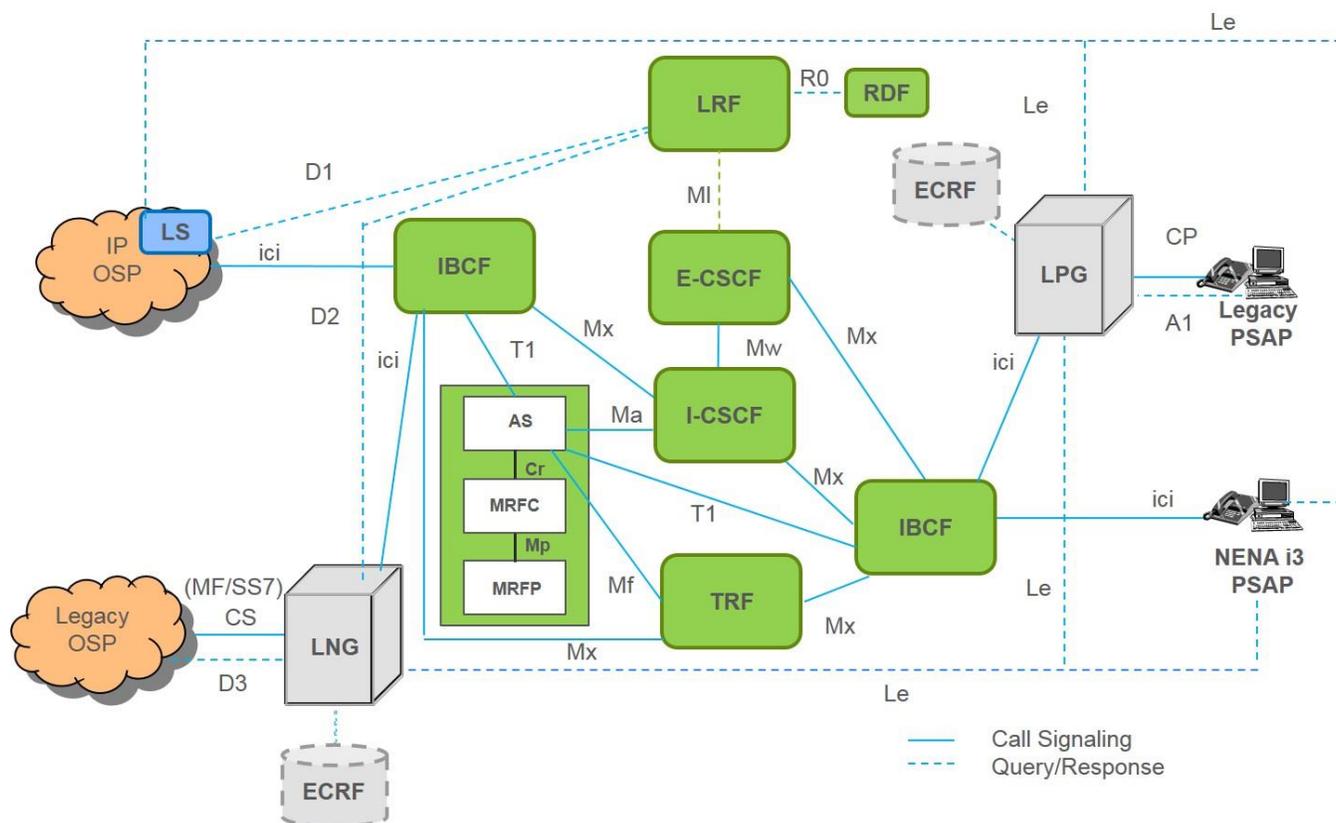


Figure 7.1: IMS-Based NG9-1-1 Service Architecture

7.2 IMS-Based NG9-1-1 Service Architecture Functional Elements

This clause introduces the functional elements defined within this standard. Specific 3GPP standards are referenced for the applicable functional elements recognizing that the 3GPP standards refer to the operation of the functional elements in an IMS-based originating network. This standard refines the use of these IMS functional elements for applicability within an IMS-based NG9-1-1 Emergency Services Network. Where applicable, NENA i3 standards are referenced for detailed descriptions of the i3 functional elements that have been incorporated into the IMS-based NG9-1-1 Service Architecture described in this standard.

7.2.1 Emergency Call Session Control Function (E-CSCF)

The Emergency Call Session Control Function is used here as defined in 3GPP TS 23.167 [Ref 1] and its applicability is extended in this standard.

The E-CSCF receives the emergency session establishment request from the Interrogating Call Session Control Function (I-CSCF), queries the LRF for routing information, and forwards the call request toward the appropriate

PSAP per the routing information. After initial call routing to the appropriate PSAP, the E-CSCF may or may not remain in the call path per implementation.

7.2.2 Interrogating Call Session Control Function (I-CSCF)

The Interrogating Call Session Control Function is used here as defined in 3GPP TS 23.228 [Ref 15] and its applicability is extended in this standard. Emergency call requests are received from the Interconnection Border Control Function (IBCF). The I-CSCF forwards the emergency call request to the provisioned (or pre-configured) E-CSCF.

7.2.3 Location Retrieval Function (LRF)

The Location Retrieval Function (LRF) is used here as defined in 3GPP TS 23.167 [Ref 1] and its applicability is extended within this standard.

The LRF is queried by the E-CSCF and may obtain location information from the LS in the IP Originating Service Provider Network or from the LNG if it is not provided in the call request (i.e., the location information is provided by reference and not by value). Either the location obtained from the LS/LNG or the location included in the emergency call request (i.e., LbyV) is used to query the Routing Determination Function (RDF). The LRF obtains routing information for an emergency session from the RDF. It returns the routing information to the E-CSCF.

7.2.4 Routing Determination Function (RDF)

The RDF is used here as defined in 3GPP TS 23.167 [Ref 1] and its applicability is expanded within this standard.

The RDF provides routing information for an emergency session based upon the location information in a request from the LRF and a service Uniform Resource Name (URN). This routing information will either designate a PSAP (i.e., a legacy PSAP using a URI that resolves at an LPG or a NENA i3 PSAP) or a Downstream Emergency Services Network (i.e., a legacy Emergency Services Network or an NG9-1-1 Emergency Services Network).

7.2.5 Location Server (LS)

The Location Server (LS) is used here as defined in 3GPP TS 23.167 [Ref 1] and its applicability is extended in this standard. 3GPP 23.271 [Ref 5] allows the LS to be incorporated within the LRF. For this standard the LS resides within the Originating Service Provider network. If the emergency call request does not have the location information contained within it, the LRF or LPG or i3 PSAP may query the LS in the IP Originating Service Provider network to obtain it, with the following clarification. If the IP Originating Service Provider network is a non-IMS i3-compliant originating network, the LS represents a Location Information Server (LIS). If the IP Originating Service Provider network is an IMS-based network, the LS will be queried via an LRF in the Originating Service Provider network. The functionality provided by the LS, and the form of the resulting location information, are dependent upon the type of call and are out of scope for this Standard.

7.2.6 Interconnecting Border Control Function (IBCF)

The Interconnecting Border Control Function (IBCF) is used here as defined in 3GPP TS 23.228 [Ref 15] and in 3GPP TS 23.167 [Ref 1] and its applicability is expanded in this standard. In this standard the IBCF functions on the ingress side of the NG9-1-1 Emergency Services Network for calls originated from legacy and IP-based originating networks and on the egress side when terminating calls to legacy PSAPs and NENA i3 PSAPs.

7.2.7 Legacy Network Gateway (LNG)

The LNG is a signaling and media interconnection point between callers in legacy wireline/wireless originating networks and the IMS-based NG9-1-1 Emergency Services Network. The LNG is responsible for interworking the Signaling System Number 7 (SS7) or Multi-Frequency (MF) signaling that it receives from the legacy originating network to the SIP signaling used in the IMS-based NG9-1-1 Emergency Services Network. The LNG will use standard SS7-SIP interworking, as defined in ATIS-1000679.2015 [Ref 11]. To support emergency call routing, the

LNG applies service-specific interworking functionality to legacy emergency calls to allow the information provided in the call setup signaling by the wireline switch or Mobile Switching Center (MSC) (e.g., calling number/ANI, ESRK, cell site/sector represented by an ESRD) to be used as input to the retrieval of location information (i.e., routing location) from an associated location server/database. The LNG uses the location information to query an ECRF to obtain routing information in the form of a URI. Based on implementation, the ECRF could be an RDF. The LNG then forwards the call/session request to an I-CSCF in the IMS-based NG9-1-1 Emergency Services Network, using the URI provided by the ECRF, and includes callback and location information (either by-value or by-reference) in the outgoing signaling. The LNG also supports interfaces to MPCs/GMLCs in legacy wireless originating networks to support the acquisition of dispatch location. To facilitate the use of LbyR, the LNG must support a dereference interface so that it can process dereference requests from other Functional Elements or PSAPs. In addition, the LNG may generate a data structure that contains additional non-location data associated with the call (e.g., class of service, provider contact information). The LNG may include the Additional Data (or a subset of it) “by-value” in the body of the outgoing SIP message it sends to the I-CSCF, and/or it may generate a pointer/reference to that data structure. If the LNG generates a pointer/reference to an Additional Data structure, it must also support dereference requests for Additional Data.

7.2.8 Emergency Call Routing Function (ECRF)

The Emergency Call Routing Function (ECRF) is a Functional Element that exists outside of the IMS-based NG9-1-1 Emergency Services Network. The LNG queries this Functional Element using the Location to Service Translation (LoST) protocol defined in IETF RFC 5222 [Ref 6] to obtain routing information for an emergency origination. The LPG may query the ECRF (using the LoST protocol) to obtain the identity of the transfer-to party associated with a transfer request from a legacy PSAP. The ECRF maps location information (either civic address or geo-coordinates) and a Service URN provided by the LNG in the routing query to a URI associated with an I-CSCF in the IMS-based NG9-1-1 Emergency Services Network. The ECRF is out of scope for this standard.

7.2.9 Legacy PSAP Gateway (LPG)

The LPG is a signaling and media interconnection point between the IMS-based NG9-1-1 Emergency Services Network and legacy PSAPs. The LPG is responsible for interworking the SIP signaling that it receives from the IMS-based NG9-1-1 Emergency Services Network to the Traditional MF or Enhanced MF (E-MF) signaling supported by the legacy PSAP. The LPG is also responsible for providing emergency services-specific processing associated with transfer requests to and from legacy PSAPs, and for processing and responding to location queries from legacy PSAPs. The LPG also supports dereference interfaces that allow it to send dereference requests to the appropriate elements to obtain LbyV and Additional Data (including EIDDs) “by-value” when presented with the associated reference URIs in incoming SIP signaling. The LPG may query the ECRF to obtain the identity of the transfer-to party when a transfer request is received from a Primary legacy PSAP. Note that for initial call setup, the LPG does not need to query the ECRF for routing the call to an appropriate PSAP since all necessary information for call routing to an appropriate PSAP is provided to the LPG in the initial INVITE message.

7.2.10 Application Server (AS)

The Application Server (AS) is used here as defined in 3GPP TS 23.002 [Ref 4] and 3GPP TS 24.147 [Ref 9] and its applicability is extended in this standard.

The AS receives SIP-based conference establishment requests from the I-CSCF and interacts with a Multimedia Resource Function Controller (MRFC) to support the conferencing and transfer of emergency calls between PSAPs served by the IMS-based NG Emergency Services Network.

7.2.11 Multimedia Resource Function Controller (MRFC)

The Multimedia Resource Function Controller (MRFC) is used here as defined in 3GPP TS 23.002 [Ref 4] and 3GPP TS 24.147 [Ref 9] and its applicability is extended in this standard.

The MRFC interprets information coming from an AS and controls the media stream resources in the Multimedia Resource Function Processor (MRFP) to support the conferencing and transfer of emergency calls between PSAPs served by the IMS-based NG Emergency Services Network.

7.2.12 Multimedia Resource Function Processor (MRFP)

The MRFP is used here as defined in 3GPP TS 23.002 [Ref 4] and 3GPP TS 24.147 [Ref 9] and its applicability is extended in this standard.

The MRFP provides resources to be controlled by the MRFC to support the conferencing and transfer of emergency calls between PSAPs served by the IMS-based NG Emergency Services Network. In the context of emergency call conferencing/ transfer, the MRFC provides the mixing of incoming media streams associated with multiple parties.

7.2.13 Transit Function (TRF)

The Transit Function is used here as defined in 3GPP TS 23.228 [Ref 15] and its applicability is extended in this standard. As described in 3GPP TS 23.228, a Transit Function may be used by an AS if the AS does not support routing capabilities. Under these circumstances, an AS may forward an originating request to the Transit Function and the Transit Function will route the session initiation request to the destination. 3GPP allows the Transit Function to reside in a stand-alone entity or to be combined with the functionality of a Media Gateway Control Function (MGCF), a Breakout Gateway Control Function (BGCF), a Serving-Call Session Control Function (S-CSCF), or an IBCF. In the context of the IMS-based NG9-1-1 Service Architecture, the Transit Function may be used, as an operator option, to support transfer scenarios where an AS has to initiate signaling toward a transfer-to PSAP that is outside of the IMS-based Next Generation Emergency Services Network.

7.3 Internetwork Architectural Configuration

Figure 7.2 extends Figure 7.1 to illustrate the concept of network interconnection for the purpose of delivering emergency calls to an interconnected emergency services network or transferring calls between emergency services networks.

When a call enters the Upstream IMS-based NG9-1-1 Emergency Services Network¹², it may be routed to a PSAP served by that network or it may send the call to a downstream emergency services network. In the case of an IMS-based NG9-1-1 Emergency Services Network to IMS-based NG9-1-1 Emergency Services Network call, the use case may be where there is a hierarchy of emergency services networks and the Upstream IMS-based NG9-1-1 Emergency Services Network sends the call to the Downstream IMS-based NG9-1-1 Emergency Services Network to be delivered to the PSAP served by the Downstream Emergency Services Network. There may be Geographic Information System (GIS) boundary cases where the Upstream IMS-based NG9-1-1 Emergency Services Network determines that the call should be handled by a Downstream IMS-based NG9-1-1 Emergency Services Network (which really means a peer emergency services network that may handle that geographic area). Likewise, there may be scenarios where an Upstream IMS-based NG9-1-1 Emergency Services Network sends an emergency call to a downstream i3 NG9-1-1 Emergency Services Network. In addition, there may be cases where calls entering an Upstream IMS-based NG9-1-1 Emergency Services Network must be sent to a legacy Emergency Services Network. The corollary is also true where calls from a legacy Emergency Services network may be sent to an IMS-based NG9-1-1 Emergency Services Network or i3 NG9-1-1 Emergency Services Network. (Note that scenarios where emergency calls pass between legacy Emergency Services Networks and i3 NG9-1-1 Emergency Services Networks without the involvement of an IMS-based NG9-1-1 Emergency Services Network are outside the scope of this specification.)

In addition, calls may be transferred from one emergency services network to another. For example, a PSAP served by an Upstream IMS-based NG9-1-1 Emergency Services Network may transfer a call to a PSAP in a Downstream IMS-based NG9-1-1 Emergency Services Network. Calls may also be transferred between PSAPs in an IMS-based NG9-1-1 Emergency Services Network and PSAPs in a legacy Emergency Services Network, or between PSAPs

¹² The terms Upstream IMS-based NG9-1-1 Emergency Services Network and Upstream Legacy Emergency Services Network are meant to imply the originating emergency services network that is sending an emergency request (initial or bridged) to another emergency services network. The terms Downstream IMS-based NG9-1-1 Emergency Services Network and Downstream Legacy Emergency Services Network are meant to imply the emergency services network that is receiving the initial call request from the other emergency services network or is the recipient of the call transfer.

served by an IMS-based NG9-1-1 Emergency Services Network and PSAPs served by i3 NG9-1-1 Emergency Services Networks, and vice versa.

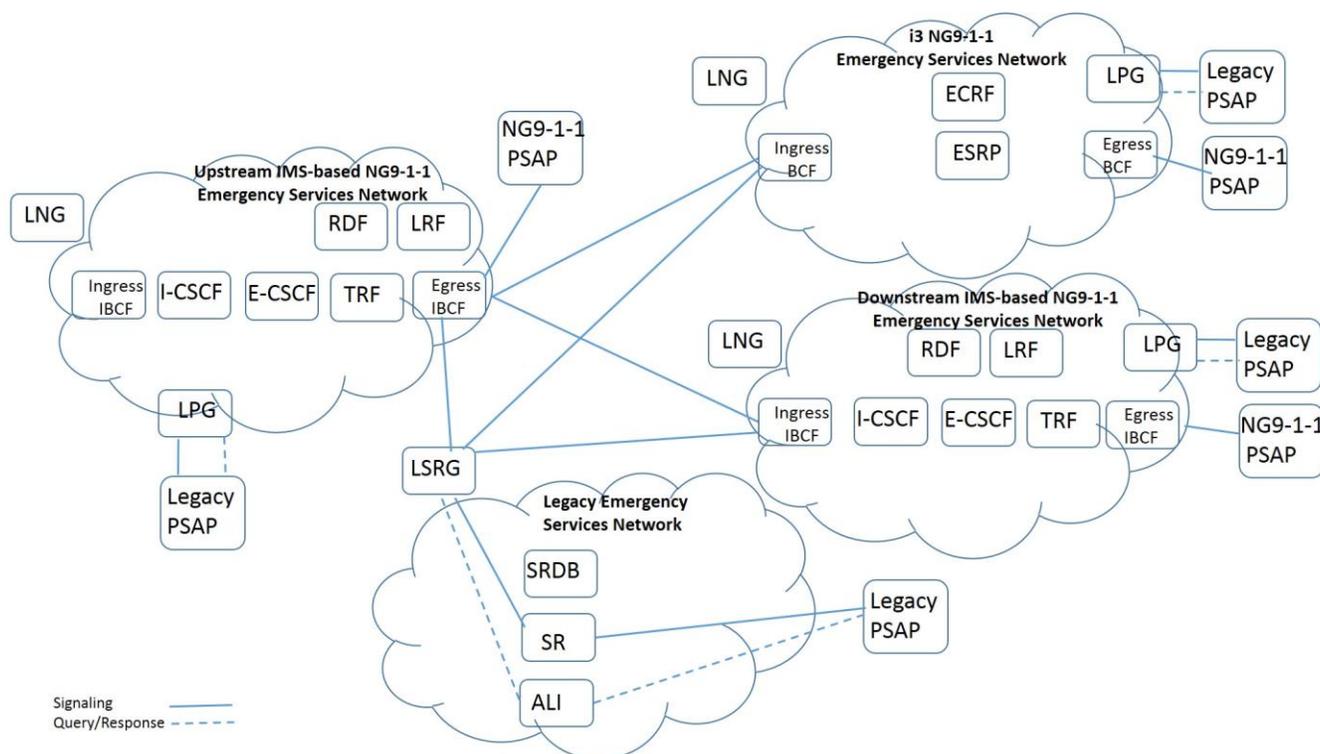


Figure 7.2: Internetwork Architectural Configuration

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

The following is the definition for the LSRG as specified in the NENA NG9-1-1 Transition Plan Information Document (NENA-INF-008.1) [Ref 103]:

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

7.4 Reference Protocols

This clause defines the protocols in the IMS-based NG9-1-1 Service Architecture. It defines specific protocols and differences from those defined in 3GPP TS 23.167 [Ref 1].

Figure 7.1 illustrates the architecture for location acquisition and routing for emergency services. Figure 7.2 illustrates network interconnection for the purpose of delivering emergency calls to an interconnected emergency services network or transferring calls between emergency services networks. The reference points associated with the functional elements illustrated in these figures are described below:

- *E-CSCF to LRF Reference Point (MI)*

The MI interface is defined in 3GPP TS 23.167 [Ref 1] and expanded upon in Clauses 5.11 and 5.12 of 3GPP TS 24.229 [Ref 2]. The LRF operates as a SIP redirecting server to the E-CSCF. The E-CSCF sends a SIP INVITE to the LRF passing sufficient information in the headers and/or body to allow the LRF to

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acquire location if necessary and determine routing (via the RDF). The LRF responds with a SIP 300 Multiple Choices response containing routing information.

- *LRF to RDF Reference Point (R0)*

The R0 Reference point is used by the LRF to obtain routing URIs from the RDF. The protocol between the LRF and the RDF is the Location to Service Translation Protocol (LoST) [Ref 6]. Using this protocol, the location and the service URN are sent to the RDF and a routing URI is returned. The LoST messages findService and findServiceResponse are used. It is assumed that the RDF returns a SIP URI in all cases, regardless of the destination (e.g., legacy or NENA i3 PSAP).
- *LRF to LS Reference Point (D1)*

The D1 Reference Point is specific to location acquisition for call routing where the emergency call request contains a location reference and the LRF has to query the IP Originating Service Provider network. The protocol used on the D1 Reference Point is the Dereferencing Protocol using HTTP Enabled Location Protocol (HELD) [Ref 8]. The HELD messages locationRequest and locationResponse are used. The use of SIP SUBSCRIBE/NOTIFY is for future study.
- *LRF to LNG Reference Point (D2)*

The D2 Reference Point is specific to location acquisition for call routing where the emergency call request contains a location reference and the LRF has to query the LNG. The protocol used on the D2 Reference Point is the Dereferencing Protocol using HTTP Enabled Location Protocol (HELD) [Ref 8]. The HELD messages locationRequest and locationResponse are used. The use of SIP SUBSCRIBE/NOTIFY [Ref 13] is for future study.
- *LNG to Ingress IBCF (ici)*

The ici Reference Point is used by the LNG to deliver emergency sessions requests toward the PSAP via the IBCF. This Reference Point uses the SIP protocol.
- *Egress IBCF to LPG (ici)*

The ici Reference Point is used by the IBCF to deliver emergency sessions requests toward a legacy PSAP via the LPG. This Reference Point uses the SIP protocol.
- *IP OSP to Ingress IBCF (ici)*

The ici Reference Point is used by the IP OSP to deliver emergency sessions requests toward the PSAP via the IBCF. This Reference Point uses the SIP protocol.
- *Egress IBCF to NENA i3 PSAP (ici)*

The ici Reference Point is used by the IBCF to deliver emergency sessions requests toward a NENA i3 PSAP. This Reference Point uses the SIP protocol.
- *I-CSCF to AS Reference Point (Ma)*

The Ma interface is defined in 3GPP TS 23.002 [Ref 4] and is used to forward SIP requests from an I-CSCF to an AS. In the context of emergency call transfer, the Ma reference point is used to forward conference establishment requests initiated by Primary i3 PSAPs or LPGs (on behalf of Primary legacy PSAPs). The protocol to be used on the Ma reference point is SIP.
- *AS to MRFC Reference Point for Media Control (Cr)*

The Cr interface is defined in 3GPP TS 23.002 [Ref 4]. The Cr reference point allows interaction between an AS and an MRFC for media control. The Cr reference point enables media control protocol requests, responses and notifications to be sent between the MRFC and an AS. The establishment and management of the media control protocol are done via SIP messages sent between the AS and the MRFC.
- *MRFC to MRFP Reference Point (Mp)*

The Mp interface is defined in 3GPP TS 23.002 [Ref 4]. The Mp reference point allows an MRFC to control media stream resources provided by an MRFP. The protocol for the Mp reference point is described in TS 29.333 [Ref 25].

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- *IBCF to AS Reference Point (T1)*

The T1 Reference Point supports communication between an IBCF and an AS in support of emergency call transfer between PSAPs served by an IMS-based NG Emergency Services Network. Once a Primary i3 PSAP or LPG has established a conference with a conferencing AS, subsequent requests and responses related to the transfer of an emergency call may involve direct communication between the conferencing AS and an IBCF over the T1 reference point. The protocol to be used on the T1 reference point is SIP.
- *AS to Transit Function (Mf)*

The Mf Reference Point supports communication between an AS and a Transit Function. In the context of the IMS-based NG9-1-1 Service Architecture, the Mf Reference Point supports emergency call transfer. The Mf Reference Point uses the SIP protocol.
- *Transit Function to IBCF (Mx)*

The Mx Reference Point supports the exchange of messages between an IBCF and other functional elements in an IMS network. In the context of the IMS-based NG9-1-1 Service Architecture, communication between the Transit Function and the IBCF to support emergency call transfer utilizes SIP signaling over the Mx Reference Point.
- *Egress IBCF in Upstream IMS-based NG9-1-1 Emergency Services Network to Ingress IBCF in Downstream IMS-based NG9-1-1 Emergency Services Network (ici)*

The ici Reference Point is used by the IBCF to deliver emergency session requests to the Downstream IMS-based NG9-1-1 Emergency Services Network for initial and bridged calls. This Reference Point uses the SIP protocol.
- *Egress IBCF in Upstream IMS-based NG9-1-1 Emergency Services Network to Ingress BCF in i3 NG9-1-1 Emergency Services Network (ici)*

The ici Reference Point is used by the IBCF to deliver emergency session requests to the i3 NG9-1-1 Emergency Services Network for initial and bridged calls. This Reference Point uses the SIP protocol.
- *Egress BCF in i3 NG9-1-1 Emergency Services Network to Ingress IBCF in Downstream IMS-based NG9-1-1 Emergency Services Network (ici)*

The ici Reference Point is used by the BCF in an i3 NG9-1-1 Emergency Services Network to deliver emergency session requests to an IMS-based NG9-1-1 Emergency Services Network for initial and bridged calls. This Reference Point uses the SIP protocol.
- *Egress IBCF in Upstream IMS-based NG9-1-1 Emergency Services Network to LSRG (ici)*

The ici Reference Point is used by the IBCF to deliver emergency session requests to the LSRG for initial and bridged calls. This Reference Point uses the SIP protocol.
- *LSRG to Ingress IBCF in Downstream IMS-based NG9-1-1 Emergency Services Network (ici)*

The ici Reference Point is used by the LSRG to deliver emergency session requests to an IMS-based NG9-1-1 Emergency Services Network for initial and bridged calls. This Reference Point uses the SIP protocol.
- *LSRG to Selective Router*

This bidirectional interface is used to communicate between the IMS-based NG9-1-1 Emergency Services Network and the legacy Emergency Services Network. This interface uses the SS7 protocol following the guidelines in NENA 03-003 [Ref 102].
- *LRF to LSRG Reference Point (D3)*

The D3 Reference Point is specific to location acquisition for call routing where the emergency call request contains a location reference and the LRF has to query the LSRG. The protocol used on the D3 Reference Point is the Dereferencing Protocol using HTTP Enabled Location Protocol (HELD) [Ref 8]. The HELD messages locationRequest and locationResponse are used. The use of SIP SUBSCRIBE/NOTIFY [Ref 13] is for future study.

Note that the Le Reference Point that allows location dereference requests to be directed to an LRF, as defined in 3GPP TS 23.167 [Ref 1], is not applicable to LRFs operating within an IMS-based NG9-1-1 Emergency Services Network. For call requests that are directed to PSAPs that are served by an IMS-based NG9-1-1 Emergency Services Network and that contain a location reference, the NENA i3 PSAP will either query the LNG on the ingress side of the upstream IMS-based or i3 NG9-1-1 Emergency Services Network, or the IP OSP network for location information. For call requests that contain a location reference and are directed to a legacy PSAP that is served by an IMS-based NG9-1-1 Emergency Services Network, the legacy PSAP will query the LPG, which in turn will either query the LNG or the IP OSP network for location information. Likewise, NENA i3 PSAPs that are served by downstream i3 NG9-1-1 Emergency Services Networks and received location-by-reference will query the LNG on the ingress side of the upstream IMS-based (or i3) NG9-1-1 Emergency Services Network or the IP OSP network for location information, and legacy PSAPs that are served by downstream i3 NG9-1-1 Emergency Services Networks and receive location-by-reference will query the LPG, which in turn will either query the LNG or the IP OSP network for location information.

For emergency calls (initial or bridged) routed from an IMS-based NG9-1-1 Emergency Services Network to a PSAP that is served by a legacy Emergency Network, the PSAP will query the Automatic Location Identification (ALI) system, and the ALI system will query the LSRG to obtain location information. If the LSRG received a location reference in incoming signaling from the IMS-based NG9-1-1 Emergency Services Network, the LSRG will initiate a query to the LNG or IP OSP Network using the Le interface to obtain location. For emergency calls (initial or bridged) routed from a legacy Emergency Services Network to a PSAP that is served by an IMS-based Emergency Services Network, the LSRG will query the ALI system using a PSAP-to-ALI protocol to obtain legacy location information and will translate that into a location-by-reference or location-by-value (as appropriate for the emergency call) for delivery to the IMS-based NG9-1-1 Emergency Services Network. If the LSRG delivers a location reference to the IMS-based NG9-1-1 Emergency Services Network, the LSRG will expect to receive location dereference requests for dispatch location from i3 PSAPs or LPGs (on behalf of legacy PSAPs served by the IMS-based NG9-1-1 Emergency Services Network) sent using the Le interface.

8 Stage 2 Call Flows

This clause illustrates various scenarios for emergency calls exchanged between IMS-based NG9-1-1 Emergency Services Networks, between IMS-based NG9-1-1 Emergency Services Networks and NENA i3 ESInets, and between IMS-based NG9-1-1 Emergency Services Networks and legacy Emergency Services Networks. A subset of scenarios is provided, and other scenarios can be extrapolated from these. In the following call flows, the emphasis is on the interaction between networks; specifically, what information is sent between the networks.

There are two sets of scenarios: initial calls that are received by one emergency services network and forwarded to another and calls that are transferred between a PSAP served by one network and a PSAP served by another. The terms Upstream IMS-based NG9-1-1 Emergency Services Network and Downstream IMS-based NG9-1-1 Emergency Services Network are used in the discussion. For an initial call that enters the Upstream IMS-based NG9-1-1 Emergency Services Network there may be a need to forward that call to another IMS-based NG9-1-1 Emergency Services Network (i.e. the Downstream IMS-based NG9-1-1 Emergency Services Network). There may also be a need for a PSAP served by the Upstream IMS-based NG9-1-1 Emergency Services Network to transfer a call to a PSAP in another IMS-based NG9-1-1 Emergency Services Network (i.e. Downstream IMS-based NG9-1-1 Emergency Services Network). For the interactions between an IMS-based NG9-1-1 Emergency Services Network and a legacy Emergency Services Network or i3 NG9-1-1 Emergency Services Network there may be a need to either send initial calls or bridged calls in either direction.

8.1 Initial Call to an Upstream IMS-based NG9-1-1 Network Emergency Services Forwarded to a Downstream IMS-based NG9-1-1 Emergency Services Network

Figure 8.1 and Figure 8.2 illustrate a scenario where a call enters the Upstream IMS-based NG9-1-1 Emergency Services Network and is delivered to the Downstream IMS-based NG9-1-1 Emergency Services Network. Specifically, when the LRF in the Upstream IMS-based NG9-1-1 Emergency Services Network queries the RDF (Step 5) the RDF determines that, for this location, the call should be handed off to the Downstream IMS-based NG9-1-1 Emergency Services Network for processing. There may also be a scenario where the Policy Routing

Function (PRF) in the LRF determines the call should be handed off to the Downstream IMS-based NG9-1-1 Emergency Services Network. Therefore, the LRF returns a Route URI that specifies the Downstream IMS-based NG9-1-1 Emergency Services Network. The call is delivered to the Downstream IMS-based NG9-1-1 Emergency Services Network and it routes the call based upon the location provided.

In this call flow example, the SIP INVITE from the Upstream IMS-based NG9-1-1 Emergency Services Network to the Downstream IMS-based NG9-1-1 Emergency Services Network (Step 9) contains (at a minimum) the following headers:

- sos in the Request Line
- Route URI that points to the well-known ingress IP address (domain) of the Downstream IMS-based NG9-1-1 Emergency Services Network
- From representing the callback number
- To as sip:911@domain
- P-Asserted-Identity representing the callback number
- Location by Value in the INVITE body represented by a Geolocation header
- Geolocation-Routing header set to “yes”
- NENA Call ID in a Call-Info header
- NENA Incident ID in a Call-Info header
- Potentially Additional Data in the body represented by a Call-Info header.
- Other normal SIP INVITE headers (e.g., Via, Call-ID, etc.).

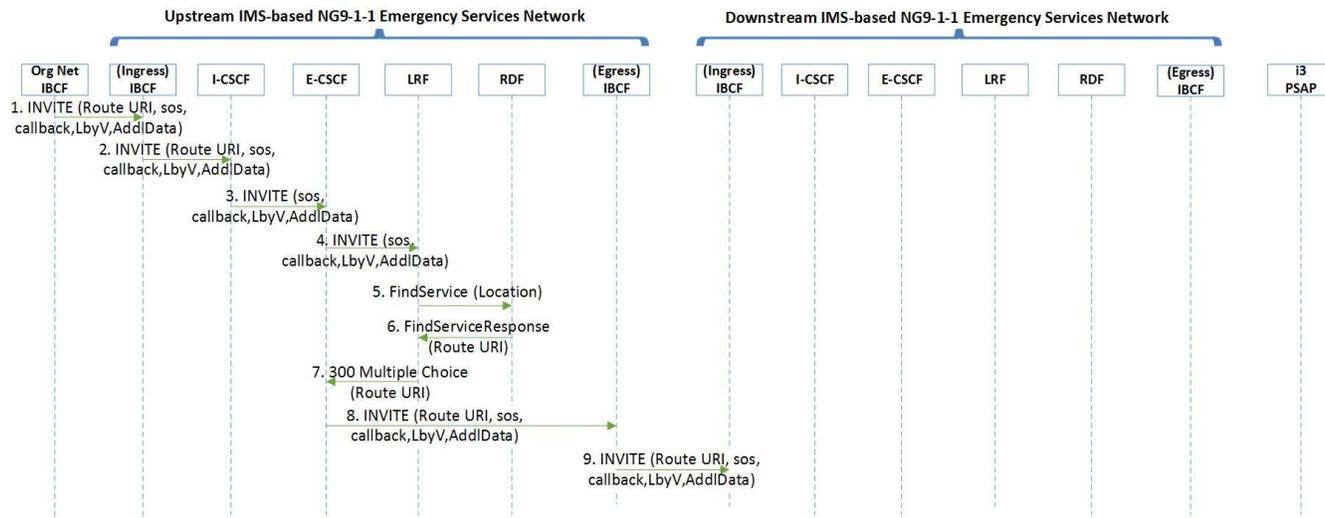


Figure 8.1: Initial Call – Upstream IMS-based NG9-1-1 Emergency Services Network to Downstream IMS-based NG9-1-1 Emergency Services Network – 1

- Step 1.** The IBCF in the originating network sends an emergency call origination to an (ingress) IBCF in the IMS-based NG9-1-1 Emergency Services Network. The SIP INVITE message includes a Route header that contains the I-CSCF URI, an emergency services service URN (urn:service:sos), callback information, LbyV, and Additional Data (by value).
- Step 2.** The (ingress) IBCF forwards the received INVITE message to the I-CSCF.

- Step 3.** The I-CSCF forwards the SIP INVITE to the pre-configured E-CSCF. The SIP INVITE message sent to the E-CSCF by the I-CSCF contains the E-CSCF URI in the Route header, and includes the callback information, “sos” service URN, LbyV, and Additional Data (by value), as received in the incoming SIP INVITE message.
- Step 4.** The E-CSCF forwards the SIP INVITE to the LRF.
- Step 5.** The LRF queries the RDF using the location information received in the body of the received SIP INVITE message and the emergency service URN (urn:service:sos).
- Step 6.** The RDF returns a Route URI. In this example, the Route URI is associated with a Downstream IMS-based NG9-1-1 Emergency Services Network.
- Step 7.** The LRF redirects the call back to the E-CSCF, passing the Route URI.
- Step 8.** The E-CSCF generates an outgoing SIP INVITE message, using the information received from the LRF as well as information received in the initial SIP INVITE message, and forwards it to the (egress) IBCF. The SIP INVITE message contains the Route URI of the I-CSCF in the Downstream IMS-based Emergency Services Network in the Route header, the sos service URN in the Request-URI, the callback information in the From and P-Asserted-Identity headers, the LbyV in the body (along with a cid in the Geolocation header and a Geolocation-Routing header set to “yes”), and Additional Data (by value) in the body (along with a cid in the Call-Info header).
- Step 9.** The egress IBCF forwards the SIP INVITE to the ingress IBCF in the Downstream IMS-based NG9-1-1 Emergency Services Network with all of the information specified in the last step.

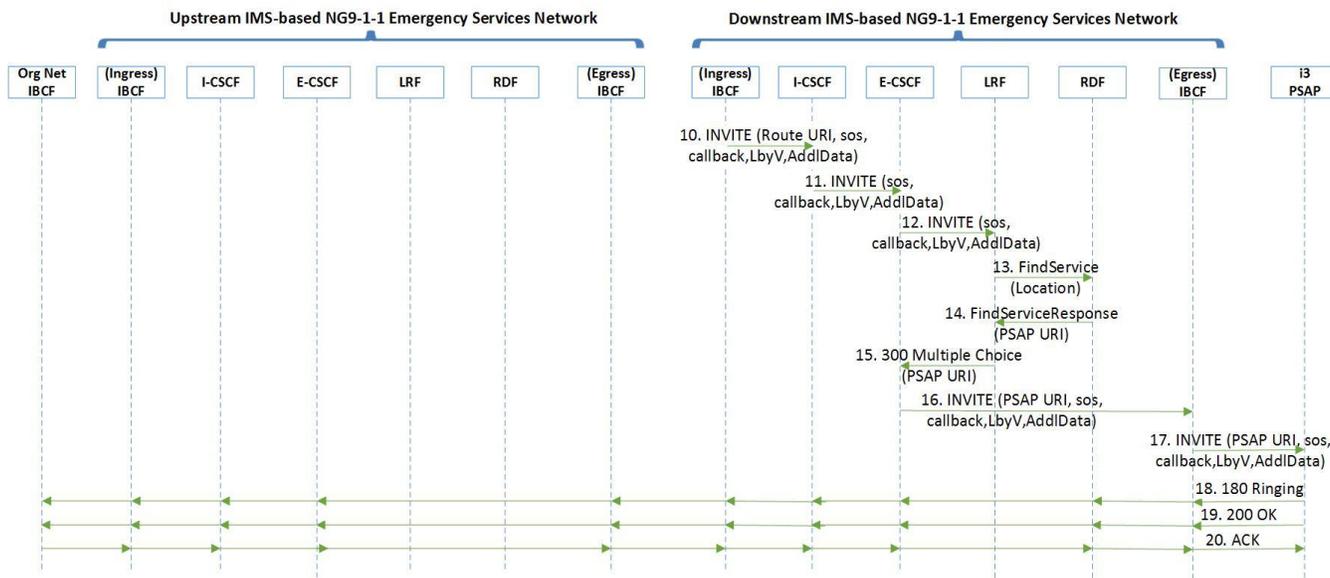


Figure 8.2: Initial Call Upstream IMS-based NG9-1-1 Emergency Services Network to Downstream IMS-based NG9-1-1 Emergency Services Network – 2

- Step 10.** The (ingress) IBCF forwards the received INVITE message to the I-CSCF.
- Step 11.** The I-CSCF forwards the SIP INVITE to the pre-configured E-CSCF. The SIP INVITE message sent to the E-CSCF by the I-CSCF contains the E-CSCF URI in the Route header, and includes the callback information, “sos” service URN, LbyV, and Additional Data (by value), as received in the incoming SIP INVITE message.
- Step 12.** The E-CSCF forwards the SIP INVITE to the LRF.
- Step 13.** LRF queries the RDF using the location information received in the body of the received SIP INVITE message and the emergency service URN (urn:service:sos).

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- Step 14.** The RDF returns a Route URI. In this example, the Route URI (PSAP URI) is associated with an i3 PSAP.
- Step 15.** The LRF redirects the call back to the E-CSCF, passing the PSAP URI.
- Step 16.** The E-CSCF generates an outgoing SIP INVITE message, using the information received from the LRF as well as information received in the initial SIP INVITE message, and forwards it to the (egress) IBCF. The SIP INVITE message contains the Route URI of the PSAP in the Route header, the sos service URN in the Request-URI, the callback information in the From and P-Asserted-Identity headers, the LbyV in the body (along with a cid in the Geolocation header and a Geolocation-Routing header set to “yes”), and Additional Data (by value) in the body (along with a cid in the Call-Info header).
- Step 17.** The egress IBCF forwards the SIP INVITE to the PSAP with all of the information specified in the last step.
- Step 18.** The PSAP sends 180 Ringing back through the SIP session path.
- Step 19.** The PSAP returns a 200 OK through the SIP session path.
- Step 20.** The originating network sends ACK back through the SIP session path.

8.1.1 Alternate Call Flow Scenarios

Location by Reference

Instead of Location by Value being provided in the initial SIP INVITE, the SIP INVITE may contain Location by Reference with a location URI specified in the Geolocation header. For this scenario, the LRF in the Upstream IMS-based NG9-1-1 Emergency Services Network would have to query the element identified in the location URI for location and use that location to determine the route. Once the Downstream IMS-based NG9-1-1 Emergency Services Network receives the call the LRF in that network would have to query the same element for location and use that location to determine the route toward the PSAP.

Additional Data by Reference

Instead of Additional Data being provided “by value” in the initial SIP INVITE, the SIP INVITE may contain a dereferencing URI in a Call-Info header. This will only be dereferenced by the LRF in the Upstream IMS-based NG9-1-1 Emergency Services Network or the LRF in the Downstream IMS-based NG9-1-1 Emergency Services Network if Additional Data is to be used for policy-based routing. Regardless, the reference URI will be forwarded to the i3 PSAP and the i3 PSAP will dereference it.

Legacy Network Gateway in Upstream IMS-based NG9-1-1 Emergency Services Network

Instead of an IP-based originating network, the originating network could be a legacy network. In that case, the signaling from the legacy originating network would enter an LNG. The LNG will obtain location information and additional data and will format that information appropriately for delivery to the IMS-based NG9-1-1 Emergency Services Network – i.e., in the Presence Information Data Format – Location Object (PIDF-LO) and/or Additional Data structures. (See Clause 8.1.1 of ATIS-0500032 [Ref 26].) The call flow will then proceed as described in Step 1 of Figure 8.1, with the LNG delivering the call to the IBCF.

Legacy PSAP Served by the Downstream IMS-based NG9-1-1 Emergency Services Network

Instead of the Downstream IMS-based NG9-1-1 Emergency Services Network delivering the call to an i3 PSAP it may deliver the call to a legacy PSAP via an LPG. In that case, the INVITE in Step 17 of Figure 8.2 would go to an LPG. The LPG would create a pANI and format the outgoing signaling as appropriate for that legacy PSAP. When the call is delivered to the legacy PSAP, it will query the LPG for location information, call back number and additional information. (See Clause 8.1.2 of ATIS-0500032 [Ref 26] for further details.)

8.2 Initial Call to an Upstream IMS-based NG9-1-1 Emergency Services Network Forwarded to a Legacy Emergency Services Network

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

The SS7 signaling from the LSRG to the SR should follow the Direct Routing/Transfer at 2nd Tandem method as defined in NENA 03-003 [Ref 102]. The Initial Address Message (IAM) from the LSRG to the SR will contain the following information:

- *CallingPartyNumber* – The pANI defined by the LSRG.
- *CalledPartyNumber* - A digit sequence which will cause the E9-1-1 Tandem (SR) to route the call to the correct destination. Typically, this is a 7 or 10-digit telephone number corresponding to the main number of the destination PSAP.

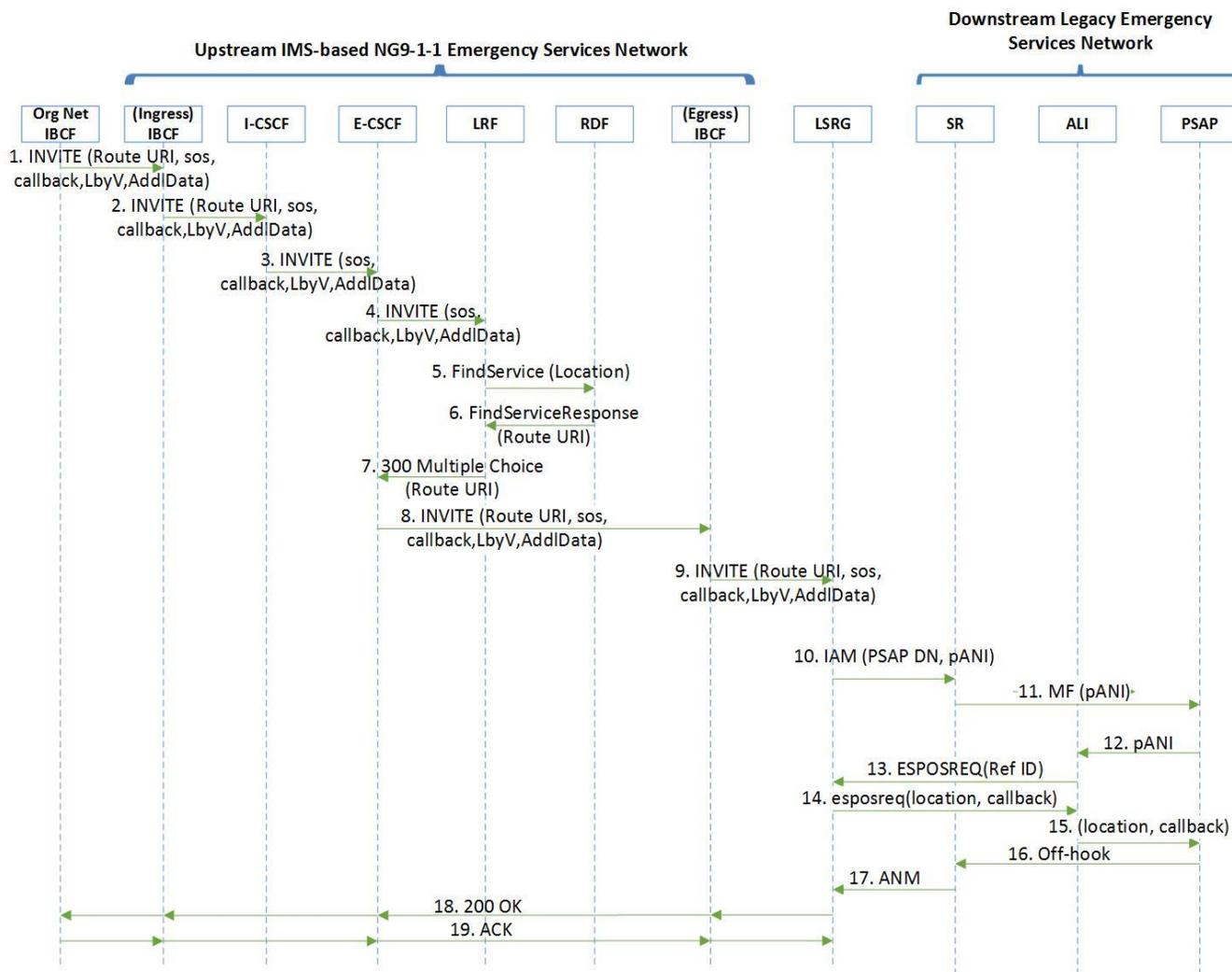


Figure 8.3: Initial Call – IMS-based NG9-1-1 Emergency Services Network to Legacy Emergency Services Network

- Step 1.** The IBCF in the originating network sends an emergency call origination to an (ingress) IBCF in the IMS-based NG9-1-1 Emergency Services Network. The SIP INVITE message includes a Route header that contains the I-CSCF URI, an emergency services service URN (urn:service:sos), callback information, LbyV, and Additional Data (by value).
- Step 2.** The (ingress) IBCF forwards the received INVITE message to the I-CSCF.
- Step 3.** The I-CSCF forwards the SIP INVITE to the pre-configured E-CSCF. The SIP INVITE message sent to the E-CSCF by the I-CSCF contains the E-CSCF URI in the Route header, and includes the callback information, “sos” service URN, LbyV, and Additional Data (by value), as received in the incoming SIP INVITE message.
- Step 4.** The E-CSCF forwards the SIP INVITE to the LRF.
- Step 5.** The LRF queries the RDF using the location information received in the body of the received SIP INVITE message and the emergency service URN (urn:service:sos).
- Step 6.** The RDF returns a Route URI. In this example, the Route URI is associated with a PSAP served by a legacy Emergency Services Network.
- Step 7.** The LRF redirects the call back to the E-CSCF, passing the Route URI.

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- Step 8.** The E-CSCF generates an outgoing SIP INVITE message, using the information received from the LRF as well as information received in the initial SIP INVITE message, and forwards it to the (egress) IBCF. The SIP INVITE message contains the Route URI of the PSAP in the legacy Emergency Services Network (i.e., a PSAP URI that resolves to an LSRG on the ingress side of the legacy Emergency Services Network) in the Route header, the sos service URN in the Request-URI, the callback information in the From and P-Asserted-Identity headers, the LbyV in the body (along with a cid in the Geolocation header and a Geolocation-Routing header set to “yes”), and Additional Data (by value) in the body (along with a cid in the Call-Info header).
- Step 9.** The (egress) IBCF forwards the SIP INVITE message to the LSRG.
- Step 10.** The LSRG caches the location and additional data information and creates a pANI based upon the Route URI it received. It initiates a SS7 IAM to the Selective Router in the legacy Emergency Services Network.
- Step 11.** Since the RDF selected the PSAP and the LSRG created a pANI appropriate to the destination PSAP, the Selective Router does not need to do selective routing. The SR sends the call request to the PSAP with the pANI. (Note: additional Centralized Automatic Message Accounting (CAMA) signaling such as Wink are not shown. Also, the potential of providing early media is not shown.)
- Step 12.** The PSAP queries the ALI system with the pANI.
- Step 13.** The ALI system queries the LSRG with the Reference Identifier (pANI).
- Step 14.** The LSRG returns the location information, callback number, and other data to the ALI system.
- Step 15.** The ALI system returns the location information, callback number, and other data to the PSAP.
- Step 16.** In parallel the PSAP returns an Off-hook.
- Step 17.** The SR returns an Answer message (ANM) to the LSRG.
- Step 18.** The LSRG initiates a 200 OK back through the SIP session path.
- Step 19.** The originating network initiates an ACK back through the SIP session path.

8.2.1 Alternate Call Flow Scenarios

Location by Reference

Instead of Location by Value being provided in the initial SIP INVITE, the SIP INVITE may contain Location by Reference with a location URI specified in the Geolocation header. For this scenario, the LRF in the Upstream IMS-based NG9-1-1 Emergency Services Network would have to query for location and use that location to determine the route. Once the LSRG receives the call request, it will have to query for location and format the location information in a manner appropriate for the legacy ALI system.

Additional Data by Reference

Instead of Additional Data being provided “by value” in the initial SIP INVITE, the SIP INVITE may contain a dereferencing URI in a Call-Info header. This will only be dereferenced by the LRF in the Upstream IMS-based NG9-1-1 Emergency Services Network if Additional Data is to be used for policy routing. The URI will be forwarded to the LSRG which will dereference it and format the resulting Additional Data as appropriate for the legacy Emergency Services Network.

Legacy Network Gateway in Upstream IMS-based NG9-1-1 Emergency Services Network

Instead of an IP-based originating network, the originating network could be a legacy network. In that case, the signaling from the legacy originating network would enter an LNG. The LNG will obtain location information and additional data and will format that information appropriately for delivery to the IMS-based NG9-1-1 Emergency Services Network (i.e., in a PIDF-LO and/or Additional Data structure). The call flow will then proceed as described in Step 1 of Figure 8.3, with the LNG delivering the call to the IBCF.

8.3 Initial Call – Legacy Emergency Services Network to IMS-based NG9-1-1 Emergency Services Network

Figure 8.4 illustrates the scenario where a wireline call is initially delivered to a legacy Emergency Services Network and is forwarded to an IMS-based NG9-1-1 Emergency Services Network for processing. Specifically, the call is sent to the SR and the SR queries the Selective Routing Database (SRDB) for routing instructions. The SRDB returns an Emergency Service Number (ESN) and that ESN is associated with a Tandem to Tandem trunk group to the LSRG. The SR then initiates a SS7 IAM toward the LSRG, the LSRG queries the ALI system for location information and other data, and the LSRG converts the legacy information into a format that is appropriate for delivery to the IMS-based NG9-1-1 Emergency Services Network (e.g. location-by-value in a PIDF-LO with a cid in the Geolocation header, and Additional Data by value in the body with a cid in a Call-Info header). The call is then routed within the IMS-based NG9-1-1 Emergency Services Network using the location information provided by the LSRG.

The SS7 signaling from the SR to the LSRG (Step 2) should follow the Selective Routing at 2nd Tandem method as defined in NENA 03-003 [Ref 102]. The IAM from the SR to the LSRG will contain the following information:

- *CallingPartyNumber* – The callback number of the original 9-1-1 caller (as received by the Selective Router)
- *CalledPartyNumber* - The digits “911”

For a wireline call, the INVITE from the LSRG to the ingress IBCF, at a minimum, will contain the following headers:

- sos in the Request Line.
- Route URI that points to the well-known ingress IP address (domain) of the Downstream IMS-based NG9-1-1 Emergency Services Network.
- From representing the callback number.
- To as sip:911@domain.
- P-Asserted-Identity representing the callback number.
- Location by Value in the INVITE body represented by a Geolocation header.
- Geolocation-Routing header set to “yes”.
- Potentially Additional Data in the body represented by a Call-Info header.
- Other normal SIP INVITE headers (e.g., Via, Call-ID, etc.).

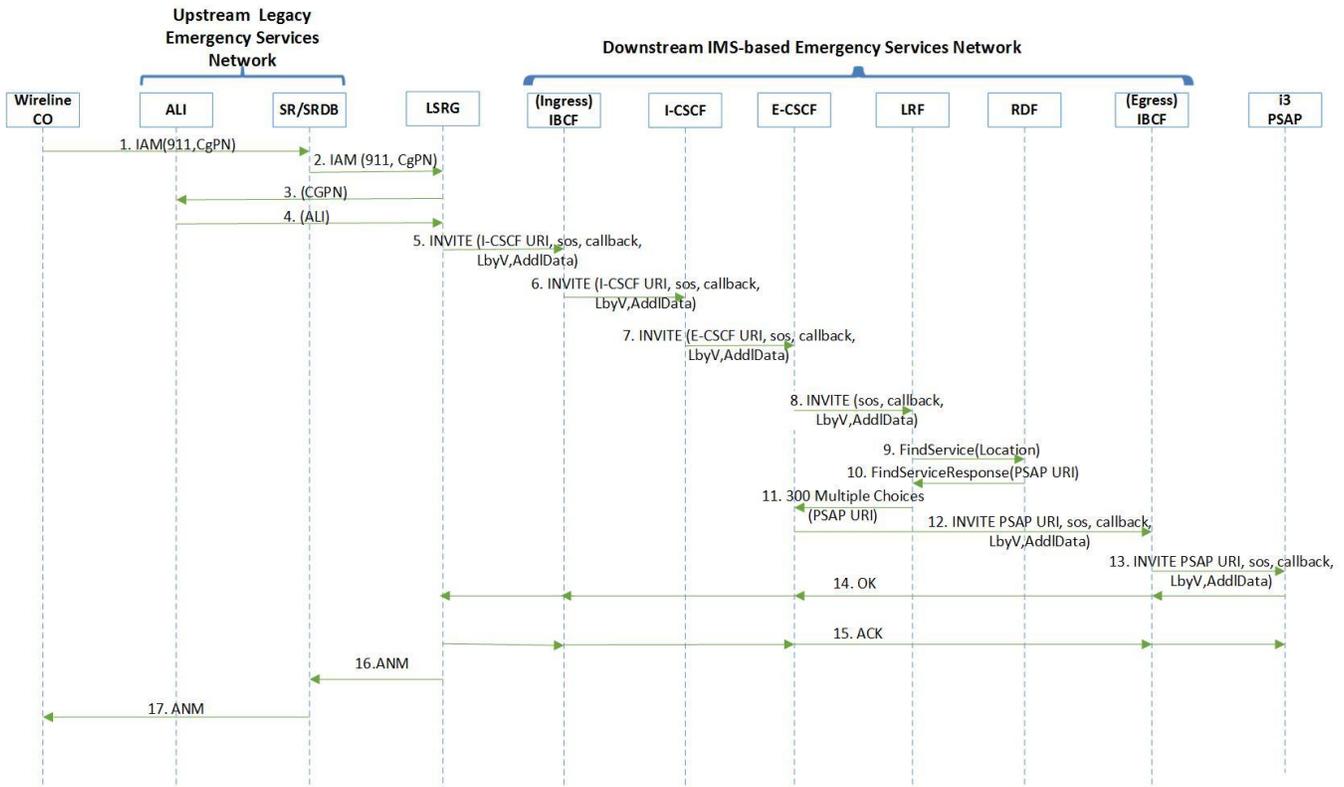


Figure 8.4: Initial Call – Legacy Emergency Services Network to IMS-based NG9-1-1 Emergency Services Network

- Step 1.** The Wireline Central Office switch initiates a 9-1-1 call using the SS7 protocol. In the IAM the Called Party Number is “911” and the Calling Party Number is the telephone number of the caller (i.e., CgPN).
- Step 2.** The SR queries its SRDB with the CgPN and the SRDB returns an ESN that points to Tandem to Tandem trunks toward the LSRG. The SR creates an SS7 IAM toward the LSRG with the Called Party Number as “911” and the Calling Party Number as the telephone number of the caller (i.e., CgPN).
- Step 3.** The LSRG queries the ALI with the CgPN to obtain legacy location information and other data.
- Step 4.** The ALI returns the legacy location information and other data.
- Step 5.** The LSRG reformats the legacy ALI information into location (i.e. PIDF-LO) and additional data information and incorporates that information into a SIP INVITE that it forwards to an (ingress) IBCF.
- Step 6.** The (ingress) IBCF forwards the SIP INVITE to the I-CSCF.
- Step 7.** The I-CSCF forwards the SIP INVITE to the pre-configured E-CSCF. The SIP INVITE message sent to the E-CSCF by the I-CSCF contains the E-CSCF URI in the Route header, and includes the callback information, “sos” service URN, LbyV, and Additional Data (by value), as received in the incoming SIP INVITE message.
- Step 8.** The E-CSCF forwards the SIP INVITE to the LRF.
- Step 9.** LRF queries the RDF using the location information received in the body of the received SIP INVITE message and the emergency service URN (urn:service:sos).
- Step 10.** The RDF returns a Route URI. In this example, the Route URI (PSAP URI) is associated with an i3 PSAP.
- Step 11.** The LRF redirects the call back to the E-CSCF, passing the PSAP URI.

- Step 12.** The E-CSCF generates an outgoing SIP INVITE message, using the information received from the LRF as well as information received in the initial SIP INVITE message, and forwards it to the (egress) IBCF. The SIP INVITE message contains the Route URI of the PSAP in the Route header, the sos service URN in the Request-URI, the callback information in the From and P-Asserted-Identity headers, the LbyV in the body (along with a cid in the Geolocation header and a Geolocation-Routing header set to “yes”), and Additional Data (by value) in the body (along with a cid in the Call-Info header).
- Step 13.** The (egress) IBCF forwards the SIP INVITE to the PSAP with all of the information specified in the last step.
- Step 14.** The PSAP returns a 200 OK through the SIP session path.
- Step 15.** The LSRG sends ACK back through the SIP session path.
- Step 16.** The LSRG sends a SS7 ANM toward the SR.
- Step 17.** The SR sends a SS7 ANM toward the Wireline Central Office switch.

8.3.1 Alternate Flows

Legacy PSAP in Downstream IMS-based NG9-1-1 Emergency Services Network

Instead of the Downstream IMS-based NG9-1-1 Emergency Services Network delivering the call to an i3 PSAP it may deliver the call to a legacy PSAP via an LPG. In that case, the INVITE in Step 13 of Figure 8.4 would go to an LPG. The LPG will create a pANI and format the signaling as appropriate for that legacy PSAP. When the call is delivered to the legacy PSAP, it will query the LPG for location information, call back number and additional information.

8.4 Initial Call to an Upstream IMS-based NG9-1-1 Emergency Services Network Forwarded to an i3 NG9-1-1 Emergency Services Network that has implemented the Ad Hoc Conference Method

Figure 8.5 illustrates a scenario where an initial emergency call enters an Upstream IMS-based NG9-1-1 Emergency Services Network and is delivered to a Downstream i3 NG9-1-1 Emergency Services Network that has implemented the Ad Hoc conference method as specified in NENA-STA-010.2. Specifically, when the LRF in the Upstream IMS-based NG9-1-1 Emergency Services Network queries the RDF (Step 5) the RDF determines that, for this location, the call should be handed off to the Downstream i3 NG9-1-1 Emergency Services Network for processing. There may also be a scenario where the PRF in the LRF determines the call should be handed off to the Downstream i3 NG9-1-1 Emergency Services Network. Therefore, the LRF returns a Route URI that is associated with an Emergency Service Routing Proxy (ESRP) in the Downstream i3 NG9-1-1 Emergency Services Network. The call is delivered to the Downstream i3 NG9-1-1 Emergency Services Network and it routes the call based upon the location provided.

In this call flow example, the SIP INVITE from the Upstream IMS-based NG9-1-1 Emergency Services Network to the Downstream i3 NG9-1-1 Emergency Services Network (Step 9) contains (at a minimum) the following headers:

- sos in the Request Line.
- Route URI that points to an ESRP in the Downstream i3 NG9-1-1 Emergency Services Network.
- From representing the callback number.
- To as sip:911@domain.
- P-Asserted-Identity representing the callback number.
- Location by Value in the INVITE body represented by a Geolocation header.
- Geolocation-Routing header set to “yes”.
- NENA Call ID in a Call-Info header.
- NENA Incident ID in a Call-Info header.
- Potentially Additional Data in the body represented by a Call-Info header.
- Other normal SIP INVITE headers (e.g., Via, Call-ID, etc.).

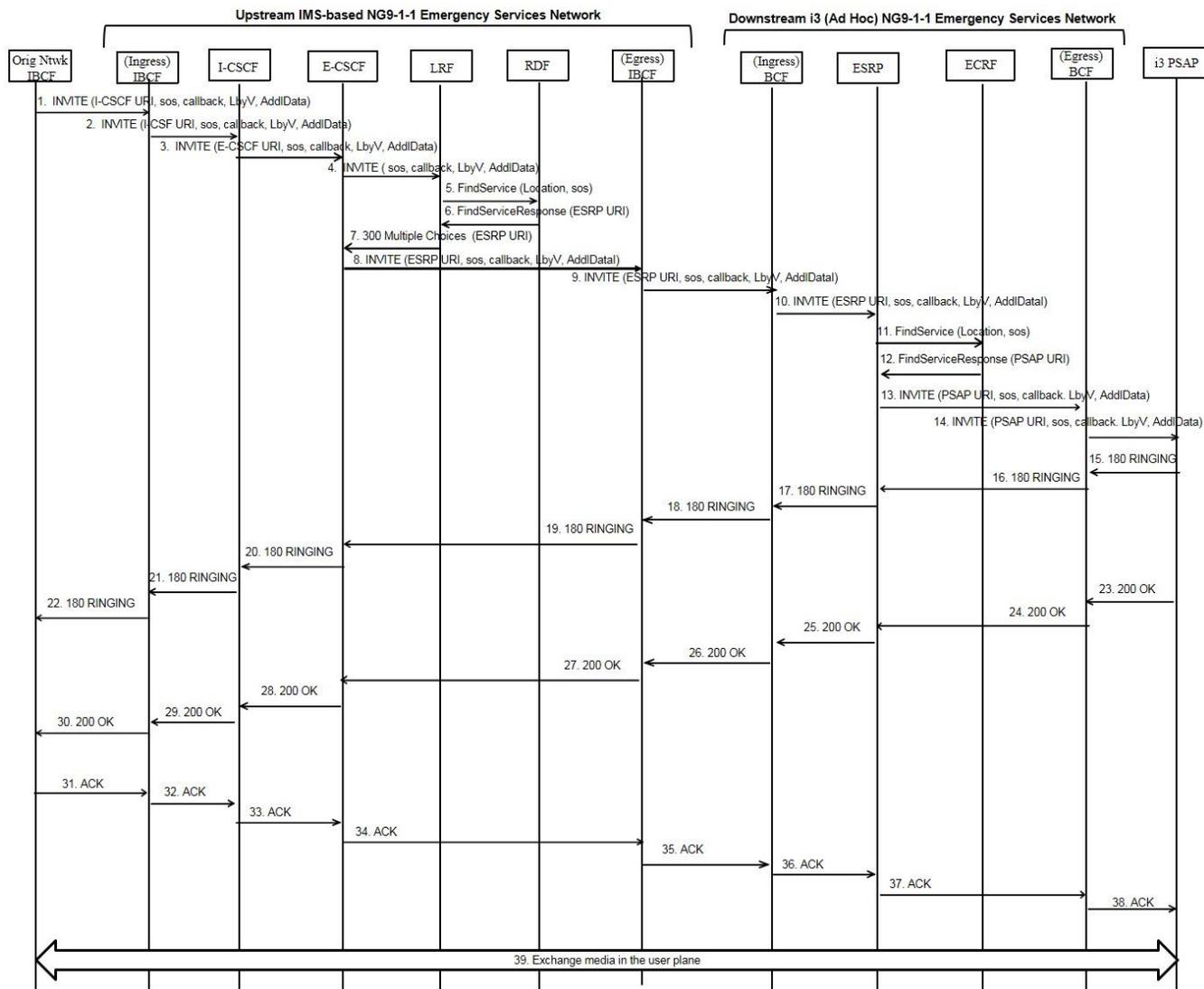


Figure 8.5: Initial Call – Upstream IMS-based NG9-1-1 Emergency Services Network to Downstream i3 (Ad Hoc) NG9-1-1 Emergency Services Network

- Step 1.** The IBCF in the originating network sends an emergency call origination to an (ingress) IBCF in the IMS-based NG9-1-1 Emergency Services Network. The SIP INVITE message includes a Route header that contains the I-CSCF URI, an emergency services service URN (urn:service:sos), callback information, LbyV, and Additional Data (by value).
- Step 2.** The (ingress) IBCF forwards the received INVITE message to the I-CSCF.
- Step 3.** The I-CSCF forwards the SIP INVITE to the pre-configured E-CSCF. The SIP INVITE message sent to the E-CSCF by the I-CSCF contains the E-CSCF URI in the Route header, and includes the callback information, “sos” service URN, LbyV, and Additional Data (by value), as received in the incoming SIP INVITE message.
- Step 4.** The E-CSCF forwards the SIP INVITE to the LRF.
- Step 5.** LRF queries the RDF using the location information received in the body of the received SIP INVITE message and the emergency service URN (urn:service:sos).
- Step 6.** The RDF returns a Route URI. In this example, the Route URI is associated with an ESRP in a Downstream i3 NG9-1-1 Emergency Services Network.

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- Step 7.** The LRF redirects the call back to the E-CSCF, passing the Route URI.
- Step 8.** The E-CSCF generates an outgoing SIP INVITE message, using the information received from the LRF as well as information received in the initial SIP INVITE message, and forwards it to the (egress) IBCF. The SIP INVITE message contains the Route URI of the ESRP in the Downstream i3 Emergency Services Network in the Route header, the sos service URN in the Request-URI, the callback information in the From and P-Asserted-Identity headers, the LbyV in the body (along with a cid in the Geolocation header and a Geolocation-Routing header set to “yes”), and Additional Data (by value) in the body (along with a cid in the Call-Info header).
- Step 9.** The egress IBCF forwards the SIP INVITE to the ingress BCF in the i3 NG9-1-1 Emergency Services Network with all of the information specified in the last step.
- Step 10.** The ingress BCF forwards the received INVITE message to the ESRP.
- Step 11.** The ESRP queries the ECRF using the location information received in the body of the received SIP INVITE message and the emergency service URN (urn:service:sos).
- Step 12.** The ECRF returns a Route URI. In this example, the Route URI (PSAP URI) is associated with an i3 PSAP.
- Step 13.** The ESRP generates an outgoing SIP INVITE message, using the information received from the ECRF as well as information received in the initial SIP INVITE message, and forwards it to the (egress) BCF. The SIP INVITE message contains the Route URI of the PSAP in the Route header, the sos service URN in the Request-URI, the callback information in the From and P-Asserted-Identity headers, the LbyV in the body (along with a cid in the Geolocation header and a Geolocation-Routing header set to “yes”), and Additional Data (by value) in the body (along with a cid in the Call-Info header).
- Step 14.** The egress BCF forwards the SIP INVITE to the i3 PSAP with all of the information specified in the last step.
- Step 15.** The i3 PSAP sends 180 RINGING back to the egress BCF.
- Step 16.** The egress BCF sends 180 RINGING to the ESRP.
- Step 17.** The ESRP sends 180 RINGING back to the ingress BCF.
- Step 18.** The ingress BCF sends 180 RINGING to the egress IBCF.
- Step 19.** The egress IBCF sends 180 RINGING to the E-CSCF.
- Step 20.** The E-CSCF sends 180 RINGING to the I-CSCF.
- Step 21.** The I-CSCF sends 180 RINGING to the ingress IBCF.
- Step 22.** The ingress IBCF sends 180 RINGING to the Originating Network IBCF.
- Step 23.** The i3 PSAP returns 200 OK to the egress BCF.
- Step 24.** The egress BCF sends 200 OK to the ESRP.
- Step 25.** The ESRP sends 200 OK to the ingress BCF.
- Step 26.** The ingress BCF sends 200 OK to egress IBCF.
- Step 27.** The egress IBCF sends 200 OK to the E-CSCF.
- Step 28.** The E-CSCF sends 200 OK to the I-CSCF.
- Step 29.** The I-CSCF sends 200 OK to the ingress IBCF.
- Step 30.** The ingress IBCF sends 200 OK to the Originating Network IBCF.
- Step 31.** The originating network sends an ACK to the ingress IBCF.
- Step 32.** The ingress IBCF sends an ACK to the I-CSCF.
- Step 33.** The I-CSCF sends an ACK to the E-CSCF.

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- Step 34.** The E-CSCF sends an ACK to the egress IBCF.
- Step 35.** The egress IBCF sends an ACK to the ingress BCF.
- Step 36.** The ingress BCF sends an ACK to the ESRP.
- Step 37.** The ESRP sends an ACK to the egress BCF.
- Step 38.** The egress BCF sends an ACK to the i3 PSAP.
- Step 39.** At this point media is flowing between the caller (via the originating network, IMS-based NG9-1-1 Emergency Services Network and i3 NG9-1-1 Emergency Services Network) and the i3 PSAP.

8.4.1 Alternate Call Flow Scenarios

Location by Reference

Instead of location-by-value being provided in the initial SIP INVITE, the SIP INVITE may contain location-by-reference with a location URI specified in the Geolocation header. For this scenario, the LRF in the Upstream IMS-based NG9-1-1 Emergency Services Network would have to query the element identified in the location URI for location and use that location to determine the route. When the call is delivered to the Downstream i3 NG9-1-1 Emergency Services Network, the ESRP in that network will have to query the same element for location and use that location to determine the route toward the PSAP. When the call is delivered to the i3 PSAP, the i3 PSAP will use the location URI to obtain location information to support dispatch.

Additional Data by Reference

If Additional Data is provided “by reference” (i.e., with a dereferencing URI in the Call-Info header) instead of “by value” in the initial SIP INVITE, a dereference request will only be initiated by the LRF in the Upstream IMS-based NG9-1-1 Emergency Services Network or the ESRP in the Downstream i3 NG9-1-1 Emergency Services Network if Additional Data is to be used for policy-based routing. The reference URI will be forwarded to the i3 PSAP and the i3 PSAP will use it to send a dereference request to obtain Additional Data “by value”.

Legacy Network Gateway in Upstream IMS-based NG9-1-1 Emergency Services Network

Instead of an IP-based originating network, the originating network could be a legacy network. In that case, the signaling from the legacy originating network would enter an LNG. The LNG will obtain location information and additional data and will format that information appropriately for delivery to the Upstream IMS-based NG9-1-1 Emergency Services Network (i.e., in the PIDF-LO and/or Additional Data structures). (See Clause 7.1 of NENA-STA-010.2 [Ref 23].) The call flow will then proceed as described in Step 1 of Figure 8.5, with the LNG delivering the call to the IBCF.

Legacy PSAP Served by the Downstream i3-based NG9-1-1 Emergency Services Network

Instead of the Downstream i3 NG9-1-1 Emergency Services Network delivering the call to an i3 PSAP it may deliver the call to a legacy PSAP via an LPG. In that case, the INVITE in Step 14 of Figure 8.5 will be sent to an LPG. The LPG will create a pANI and format the outgoing signaling as appropriate for that legacy PSAP. When the call is delivered to the legacy PSAP, it will query the LPG for location information, callback number and additional information. (See Clause 7.2 of NENA-STA-010.2 [Ref 23] for further details.)

8.5 Initial Call to an Upstream “Ad Hoc” i3 NG9-1-1 Emergency Services Network Forwarded to a Downstream IMS-based NG9-1-1 Emergency Services Network

Figure 8.6 illustrates a scenario where an initial emergency call enters an Upstream i3 NG9-1-1 Emergency Services Network that has implemented the Ad Hoc conferencing method, as specified in NENA-STA-010.2, and is delivered to a Downstream IMS-based NG9-1-1 Emergency Services Network. Specifically, when the ESRP in the

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Upstream IMS-based NG9-1-1 Emergency Services Network queries the ECRF (Step 3) the ECRF determines that, for this location, the call should be handed off to the Downstream IMS-based NG9-1-1 Emergency Services Network for processing. There may also be a scenario where the PRF in the ESRP determines the call should be handed off to the Downstream IMS-based NG9-1-1 Emergency Services Network. Therefore, the ECRF returns a Route URI that is associated with an I-CSCF in the Downstream IMS-based NG9-1-1 Emergency Services Network. The call is delivered to the Downstream IMS-based NG9-1-1 Emergency Services Network and the LRF interacts with the RDF to route the call based upon the location provided. In this call flow, the call is routed to an i3 PSAP.

In this call flow example, the SIP INVITE from the Upstream i3 NG9-1-1 Emergency Services Network to the Downstream IMS-based NG9-1-1 Emergency Services Network (Step 6) contains (at a minimum) the following headers:

- sos in the Request Line
- Route URI that points to an I-CSCF in the Downstream IMS-based NG9-1-1 Emergency Services Network
- From representing the callback number
- To as sip:911@domain
- P-Asserted-Identity representing the callback number
- Location by Value in the INVITE body represented by a Geolocation header
- Geolocation-Routing header set to "yes"
- NENA Call ID in a Call-Info header
- NENA Incident ID in a Call-Info header
- Potentially Additional Data in the body represented by a Call-Info header.
- Other normal SIP INVITE headers (e.g., Via, Call-ID, etc.)

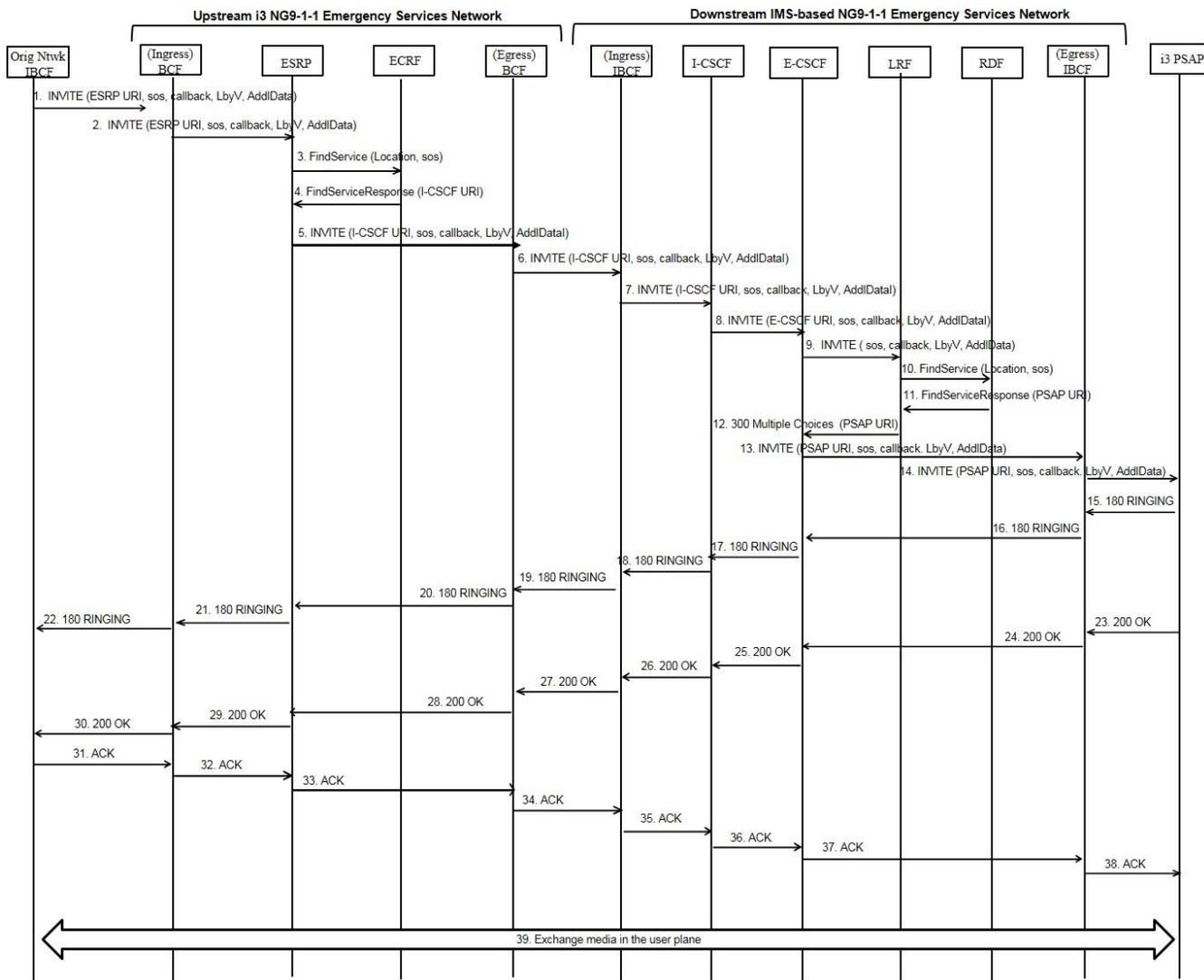


Figure 8.6: Initial Call – Upstream i3 (“Ad Hoc”) NG9-1-1 Emergency Services Network to Downstream IMS-based NG9-1-1 Emergency Services Network

- Step 1.** The IBCF in the originating network sends an emergency call origination to an (ingress) BCF in the i3 NG9-1-1 Emergency Services Network. The SIP INVITE message includes a Route header that contains the ESRP URI, an emergency services service URN (urn:service:sos), callback information, LbyV, and Additional Data (by value).
- Step 2.** The ingress BCF forwards the received INVITE message to the ESRP.
- Step 3.** The ESRP queries the ECRF using the location information received in the body of the received SIP INVITE message and the emergency service URN (urn:service:sos).
- Step 4.** The ECRF returns a Route URI. In this example, the Route URI is associated with an I-CSCF in a Downstream IMS-based NG9-1-1 Emergency Services Network.
- Step 5.** The ESRP generates an outgoing SIP INVITE message, using the information received from the ECRF as well as information received in the initial SIP INVITE message, and forwards it to the egress BCF. The SIP INVITE message contains the Route URI of the I-CSCF in the Downstream IMS-based Emergency Services Network in the Route header, the sos service URN in the Request-URI, the callback information in the From and P-Asserted-Identity headers, the LbyV in the body (along with a cid in the Geolocation header and a Geolocation-Routing

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header set to “yes”), and Additional Data (by value) in the body (along with a cid in the Call-Info header).

- Step 6.** The egress BCF forwards the SIP INVITE to the ingress IBCF in the IMS-based NG9-1-1 Emergency Services Network with all of the information specified in the last step.
- Step 7.** The ingress IBCF forwards the received INVITE message to the I-CSCF.
- Step 8.** The I-CSCF forwards the SIP INVITE to the pre-configured E-CSCF. The SIP INVITE message sent to the E-CSCF by the I-CSCF contains the E-CSCF URI in the Route header, and includes the callback information, “sos” service URN, LbyV, and Additional Data (by value), as received in the incoming SIP INVITE message.
- Step 9.** The E-CSCF forwards the SIP INVITE to the LRF.
- Step 10.** LRF queries the RDF using the location information received in the body of the received SIP INVITE message and the emergency service URN (urn:service:sos).
- Step 11.** The RDF returns a Route URI. In this example, the Route URI (PSAP URI) is associated with an i3 PSAP.
- Step 12.** The LRF redirects the call back to the E-CSCF, passing the PSAP URI.
- Step 13.** The E-CSCF generates an outgoing SIP INVITE message, using the information received from the LRF as well as information received in the initial SIP INVITE message, and forwards it to the (egress) IBCF. The SIP INVITE message contains the Route URI of the PSAP in the Route header, the sos service URN in the Request-URI, the callback information in the From and P-Asserted-Identity headers, the LbyV in the body (along with a cid in the Geolocation header and a Geolocation-Routing header set to “yes”), and Additional Data (by value) in the body (along with a cid in the Call-Info header).
- Step 14.** The egress IBCF forwards the SIP INVITE to the PSAP with all of the information specified in the last step.
- Step 15.** The i3 PSAP sends 180 RINGING back to the egress IBCF.
- Step 16.** The egress IBCF sends 180 RINGING to the E-CSCF.
- Step 17.** The E-CSCF sends 180 RINGING to the I-CSCF.
- Step 18.** The I-CSCF sends 180 RINGING back to the ingress IBCF.
- Step 19.** The ingress IBCF sends 180 RINGING to the egress BCF.
- Step 20.** The egress BCF sends 180 RINGING to the ESRP.
- Step 21.** The ESRP sends 180 RINGING to the ingress BCF.
- Step 22.** The ingress BCF sends 180 RINGING to the Originating Network IBCF.
- Step 23.** The i3 PSAP returns 200 OK to the egress IBCF.
- Step 24.** The egress IBCF sends 200 OK to the E-CSCF.
- Step 25.** The E-CSCF sends 200 OK to the I-CSCF.
- Step 26.** The I-CSCF sends 200 OK to the ingress IBCF.
- Step 27.** The ingress IBCF sends a 200 OK to egress BCF.
- Step 28.** The egress BCF sends a 200 OK to the ESRP.
- Step 29.** The ESRP sends 200 OK to the ingress BCF.
- Step 30.** The ingress BCF sends 200 OK to the Originating Network IBCF.
- Step 31.** The originating network sends ACK to the ingress BCF.
- Step 32.** The ingress BCF sends the ACK to the ESRP.
- Step 33.** The ESRP sends the ACK to the egress BCF.

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- Step 34.** The egress BCF sends the ACK to the ingress IBCF.
- Step 35.** The ingress IBCF sends the ACK to the I-CSCF.
- Step 36.** The I-CSCF sends the ACK to the E-CSCF.
- Step 37.** The E-CSCF sends the ACK to the egress IBCF.
- Step 38.** The egress IBCF sends the ACK to the i3 PSAP.
- Step 39.** At this point media is flowing between the caller (via the originating network, i3 NG9-1-1 Emergency Services Network and IMS-based NG9-1-1 Emergency Services Network) to the i3 PSAP.

8.5.1 Alternate Call Flow Scenarios

Location by Reference

Instead of location-by-value being provided in the initial SIP INVITE, the SIP INVITE may contain location-by-reference with a location URI specified in the Geolocation header. For this scenario, the ESRP in the Upstream i3 NG9-1-1 Emergency Services Network would have to query the element identified in the location URI for location and use that location to determine the route. When the call is delivered to the Downstream IMS-based NG9-1-1 Emergency Services Network, the LRF in that network will have to query the same element for location and use that location to determine the route toward the PSAP. When the call is delivered to the i3 PSAP, the i3 PSAP will use the location URI to obtain location information to support dispatch.

Additional Data by Reference

If Additional Data is provided “by reference” (i.e., with a dereferencing URI in the Call-Info header) instead of “by value” in the initial SIP INVITE, a dereference request will only be initiated by the ESRP in the Upstream i3 NG9-1-1 Emergency Services Network or the LRF in the Downstream IMS-based NG9-1-1 Emergency Services Network if Additional Data is to be used for policy-based routing. The reference URI will be forwarded to the i3 PSAP and the i3 PSAP will use it to send a dereference request to obtain Additional Data “by value”.

Legacy Network Gateway in Upstream IMS-based NG9-1-1 Emergency Services Network

Instead of an IP-based originating network, the originating network could be a legacy network. In that case, the signaling from the legacy originating network would enter an LNG. The LNG will obtain location information and additional data and will format that information appropriately for delivery to the Upstream i3 NG9-1-1 Emergency Services Network (i.e., in the PIDF-LO and/or Additional Data structures). (See Clause 7.1 of NENA-STA-010.2 [Ref 23].) The call flow will then proceed as described in Step 1 of Figure 8.6, with the LNG delivering the call to the ingress BCF.

Legacy PSAP Served by the Downstream IMS-based NG9-1-1 Emergency Services Network

Instead of the Downstream IMS-based NG9-1-1 Emergency Services Network delivering the call to an i3 PSAP it may deliver the call to a legacy PSAP via an LPG. In that case, the INVITE in Step 14 of Figure 8.6 will be sent to an LPG. The LPG will create a pANI and format the outgoing signaling as appropriate for that legacy PSAP. When the call is delivered to the legacy PSAP, it will query the LPG for location information, call back number and additional information. (See Clause 7.2 of NENA-STA-010.2 [Ref 23] for further details.)

8.6 Initial Call to an Upstream IMS-based NG9-1-1 Emergency Services Network Forwarded to an i3 NG9-1-1 Emergency Services Network that has implemented the Route All Calls via a Conference Aware UA Conference Model

Figure 8.7 illustrates a scenario where an initial emergency call enters an Upstream IMS-based NG9-1-1 Emergency Services Network and is delivered to a Downstream i3 NG9-1-1 Emergency Services Network that has implemented the Route All Calls via a Conference Aware UA conference model as specified in NENA-STA-010.3¹³ [Ref 27]. Specifically, when the LRF in the Upstream IMS-based NG9-1-1 Emergency Services Network queries the RDF (Step 5) the RDF determines that, for this location, the call should be handed off to the Downstream i3 NG9-1-1 Emergency Services Network for processing. There may also be a scenario where the PRF in the LRF determines the call should be handed off to the Downstream i3 NG9-1-1 Emergency Services Network. Therefore, the LRF returns a Route URI that is associated with an ESRP in the Downstream i3 NG9-1-1 Emergency Services Network. The call is delivered to the Downstream i3 NG9-1-1 Emergency Services Network and it routes the call based upon the location provided.

In this call flow example, the SIP INVITE from the Upstream IMS-based NG9-1-1 Emergency Services Network to the Downstream i3 NG9-1-1 Emergency Services Network (Step 9) contains (at a minimum) the following headers:

- sos in the Request Line
- Route URI that points to an ESRP in the Downstream i3 NG9-1-1 Emergency Services Network
- From representing the callback number
- To as sip:911@domain
- P-Asserted-Identity representing the callback number
- Location by Value in the INVITE body represented by a Geolocation header
- Geolocation-Routing header set to “yes”
- NENA Call ID in a Call-Info header
- NENA Incident ID in a Call-Info header
- Potentially Additional Data in the body represented by a Call-Info header.
- Other normal SIP INVITE headers (e.g., Via, Call-ID, etc.)

¹³ This i3 conference model was referred to as “Answer All Calls at a Bridge” in NENA-STA-010.2 [Ref 23]. The name has been changed to “Route All Calls via a Conference Aware UA” in the draft i3 Version 3 standard, NENA-STA-010.3 [Ref 27].

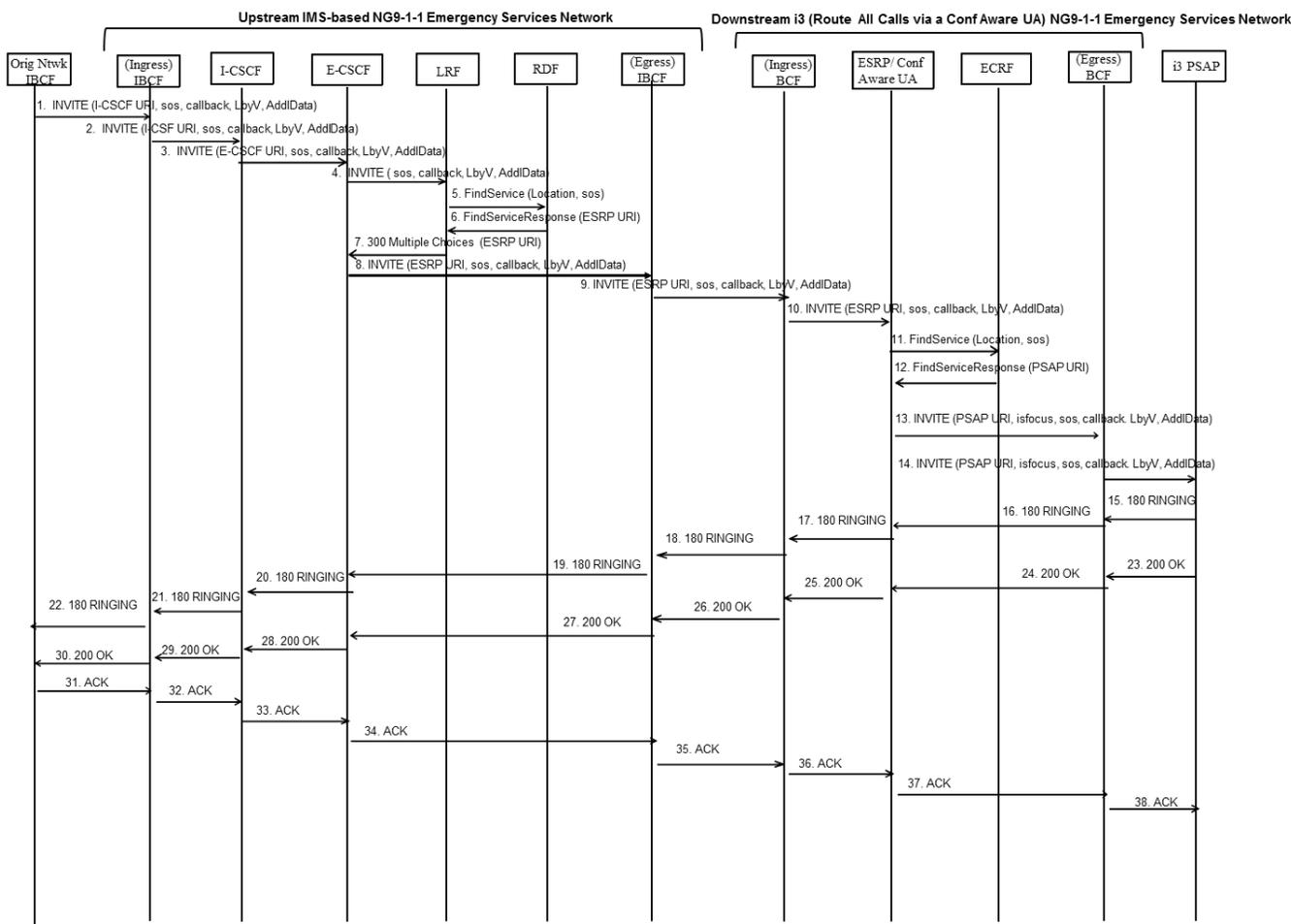


Figure 8.7: Initial Call – Upstream IMS-based NG9-1-1 Emergency Services Network to Downstream i3 (“Route All Calls via a Conference Aware UA”) NG9-1-1 Emergency Services Network

- Step 1.** The IBCF in the originating network sends an emergency call origination to an (ingress) IBCF in the IMS-based NG9-1-1 Emergency Services Network. The SIP INVITE message includes a Route header that contains the I-CSCF URI, an emergency services service URN (urn:service:sos), callback information, LbyV, and Additional Data (by value).
- Step 2.** The (ingress) IBCF forwards the received INVITE message to the I-CSCF.
- Step 3.** The I-CSCF forwards the SIP INVITE to the pre-configured E-CSCF. The SIP INVITE message sent to the E-CSCF by the I-CSCF contains the E-CSCF URI in the Route header, and includes the callback information, “sos” service URN, LbyV, and Additional Data (by value), as received in the incoming SIP INVITE message.
- Step 4.** The E-CSCF forwards the SIP INVITE to the LRF.
- Step 5.** LRF queries the RDF using the location information received in the body of the received SIP INVITE message and the emergency service URN (urn:service:sos).
- Step 6.** The RDF returns a Route URI. In this example, the Route URI is associated with an ESRP/Conference Aware UA in a Downstream i3 NG9-1-1 Emergency Services Network.
- Step 7.** The LRF redirects the call back to the E-CSCF, passing the Route URI.
- Step 8.** The E-CSCF generates an outgoing SIP INVITE message, using the information received from the LRF as well as information received in the initial SIP INVITE message, and forwards it to the (egress) IBCF. The SIP INVITE message contains the Route URI of the ESRP/Conference Aware UA in the Downstream i3 Emergency Services Network in the Route header, the sos

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service URN in the Request-URI, the callback information in the From and P-Asserted-Identity headers, the LbyV in the body (along with a cid in the Geolocation header and a Geolocation-Routing header set to “yes”), and Additional Data (by value) in the body (along with a cid in the Call-Info header).

- Step 9.** The egress IBCF forwards the SIP INVITE to the ingress BCF in the i3 NG9-1-1 Emergency Services Network with all of the information specified in the last step.
- Step 10.** The ingress BCF forwards the received INVITE message to the ESRP/Conference Aware UA.
- Step 11.** The ESRP component of the ESRP/Conference Aware UA queries the ECRF using the location information received in the body of the received SIP INVITE message and the emergency service URN (urn:service:sos).
- Step 12.** The ECRF returns a Route URI. In this example, the Route URI (PSAP URI) is associated with an i3 PSAP.
- Step 13.** The Conference Aware UA component of the ESRP/Conference Aware UA generates an outgoing SIP INVITE message, using the information received from the ECRF as well as information received in the initial SIP INVITE message, and forwards it to the (egress) BCF. The SIP INVITE message contains the Route URI of the PSAP in the Route header, the sos service URN in the Request-URI and To header, the callback information in the From and P-Asserted-Identity headers, an isfocus and a URI associated with the ESRP/Conference Aware UA in the Contact header, the LbyV in the body (along with a cid in the Geolocation header and a Geolocation-Routing header set to “yes”), and Additional Data (by value) in the body (along with a cid in the Call-Info header).
- Step 14.** The egress BCF forwards the SIP INVITE to the i3 PSAP with all of the information specified in the last step.
- Step 15.** The i3 PSAP sends 180 RINGING back to the egress BCF.
- Step 16.** The egress BCF sends 180 RINGING to the ESRP.
- Step 17.** The ESRP sends 180 RINGING back to the ingress BCF.
- Step 18.** The ingress BCF sends 180 RINGING to the egress IBCF.
- Step 19.** The egress IBCF sends 180 RINGING to the E-CSCF.
- Step 20.** The E-CSCF sends 180 RINGING to the I-CSCF.
- Step 21.** The I-CSCF sends 180 RINGING to the ingress IBCF.
- Step 22.** The ingress IBCF sends 180 RINGING to the Originating Network IBCF.
- Step 23.** The i3 PSAP returns 200 OK to the egress BCF.
- Step 24.** The egress BCF sends 200 OK to the ESRP.
- Step 25.** The ESRP sends 200 OK to the ingress BCF.
- Step 26.** The ingress BCF sends 200 OK to egress IBCF.
- Step 27.** The egress IBCF sends 200 OK to the E-CSCF.
- Step 28.** The E-CSCF sends 200 OK to the I-CSCF.
- Step 29.** The I-CSCF sends 200 OK to the ingress IBCF.
- Step 30.** The ingress IBCF sends 200 OK to the Originating Network IBCF.
- Step 31.** The originating network sends an ACK to the ingress IBCF.
- Step 32.** The ingress IBCF sends an ACK to the I-CSCF.
- Step 33.** The I-CSCF sends an ACK to the E-CSCF.
- Step 34.** The E-CSCF sends an ACK to the egress IBCF.
- Step 35.** The egress IBCF sends an ACK to the ingress BCF.

- Step 36.** The ingress BCF sends an ACK to the ESRP.
- Step 37.** The ESRP sends an ACK to the egress BCF.
- Step 38.** The egress BCF sends an ACK to the i3 PSAP.

8.6.1 Alternate Call Flow Scenarios

Location by Reference

Instead of location-by-value being provided in the initial SIP INVITE, the SIP INVITE may contain location-by-reference with a location URI specified in the Geolocation header. For this scenario, the LRF in the Upstream IMS-based NG9-1-1 Emergency Services Network would have to query the element identified in the location URI for location and use that location to determine the route. When the call is delivered to the Downstream i3 NG9-1-1 Emergency Services Network, the ESRP component of the ESRP/Conference Aware UA in that network will have to query the same element for location and use that location to determine the route toward the PSAP. When the call is delivered to the i3 PSAP, the i3 PSAP will use the location URI to obtain location information to support dispatch.

Additional Data by Reference

If Additional Data is provided “by reference” (i.e., with a dereferencing URI in the Call-Info header) instead of “by value” in the initial SIP INVITE, a dereference request will only be initiated by the LRF in the Upstream IMS-based NG9-1-1 Emergency Services Network or the ESRP component of the ESRP/Conference Aware UA in the Downstream i3 NG9-1-1 Emergency Services Network if Additional Data is to be used for policy-based routing. The reference URI will be forwarded to the i3 PSAP and the i3 PSAP will use it to send a dereference request to obtain Additional Data “by value”.

Legacy Network Gateway in Upstream IMS-based NG9-1-1 Emergency Services Network

Instead of an IP-based originating network, the originating network could be a legacy network. In that case, the signaling from the legacy originating network would enter an LNG. The LNG will obtain location information and additional data and will format that information appropriately for delivery to the Upstream IMS-based NG9-1-1 Emergency Services Network (i.e., in the PIDF-LO and/or Additional Data structures). (See Clause 7.1 of NENA-STA-010.2 [Ref 23].) The call flow will then proceed as described in Step 1 of Figure 8.7, with the LNG delivering the call to the IBCF.

Legacy PSAP Served by the Downstream i3-based NG9-1-1 Emergency Services Network

Instead of the Downstream i3 NG9-1-1 Emergency Services Network delivering the call to an i3 PSAP it may deliver the call to a legacy PSAP via an LPG. In that case, the INVITE in Step 14 of Figure 8.7 will be sent to an LPG. The LPG will create a pANI and format the outgoing signaling as appropriate for that legacy PSAP. When the call is delivered to the legacy PSAP, it will query the LPG for location information, callback number and additional information. (See Clause 7.2 of NENA-STA-010.2 [Ref 23] for further details.)

8.7 Initial Call to an Upstream “Route All Calls via a Conference Aware UA” i3 NG9-1-1 Emergency Services Network Forwarded to a Downstream IMS-based NG9-1-1 Emergency Services Network

Figure 8.8 illustrates a scenario where an initial emergency call enters an Upstream i3 NG9-1-1 Emergency Services Network that has implemented the Route All Calls via a Conference Aware UA conferencing model, as specified in NENA-STA-010.3 [Ref 27] and is delivered to a Downstream IMS-based NG9-1-1 Emergency Services Network. Specifically, when the ESRP/Conference Aware UA in the Upstream i3 NG9-1-1 Emergency Services Network queries the ECRF (Step 3) the ECRF determines that, for this location, the call should be handed off to the Downstream IMS-based NG9-1-1 Emergency Services Network for processing. Therefore, the ECRF returns a Route URI that is associated with an I-CSCF in the Downstream IMS-based NG9-1-1 Emergency Services Network.

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There may also be a scenario where the PRF in the ESRP component of the ESRP/Conference Aware UA determines that the call should be handed off to the Downstream IMS-based NG9-1-1 Emergency Services Network. The call is delivered to the Downstream IMS-based NG9-1-1 Emergency Services Network and the LRF in that network interacts with the RDF to route the call based upon the location provided. In this call flow, the call is routed to an i3 PSAP.

In this call flow example, the SIP INVITE from the Upstream i3 NG9-1-1 Emergency Services Network to the Downstream IMS-based NG9-1-1 Emergency Services Network (Step 6) contains (at a minimum) the following headers:

- sos in the Request Line
- Route URI that points to an I-CSCF in the Downstream IMS-based NG9-1-1 Emergency Services Network
- From representing the callback number
- To containing the sos service URN
- P-Asserted-Identity representing the callback number
- Contact header that contains the URI associated with the ESRP/Conference Aware UA
- Location by Value in the INVITE body represented by a Geolocation header
- Geolocation-Routing header set to "yes"
- NENA Call ID in a Call-Info header
- NENA Incident ID in a Call-Info header
- Potentially Additional Data in the body represented by a Call-Info header.
- Other normal SIP INVITE headers (e.g., Via, Call-ID, etc.)

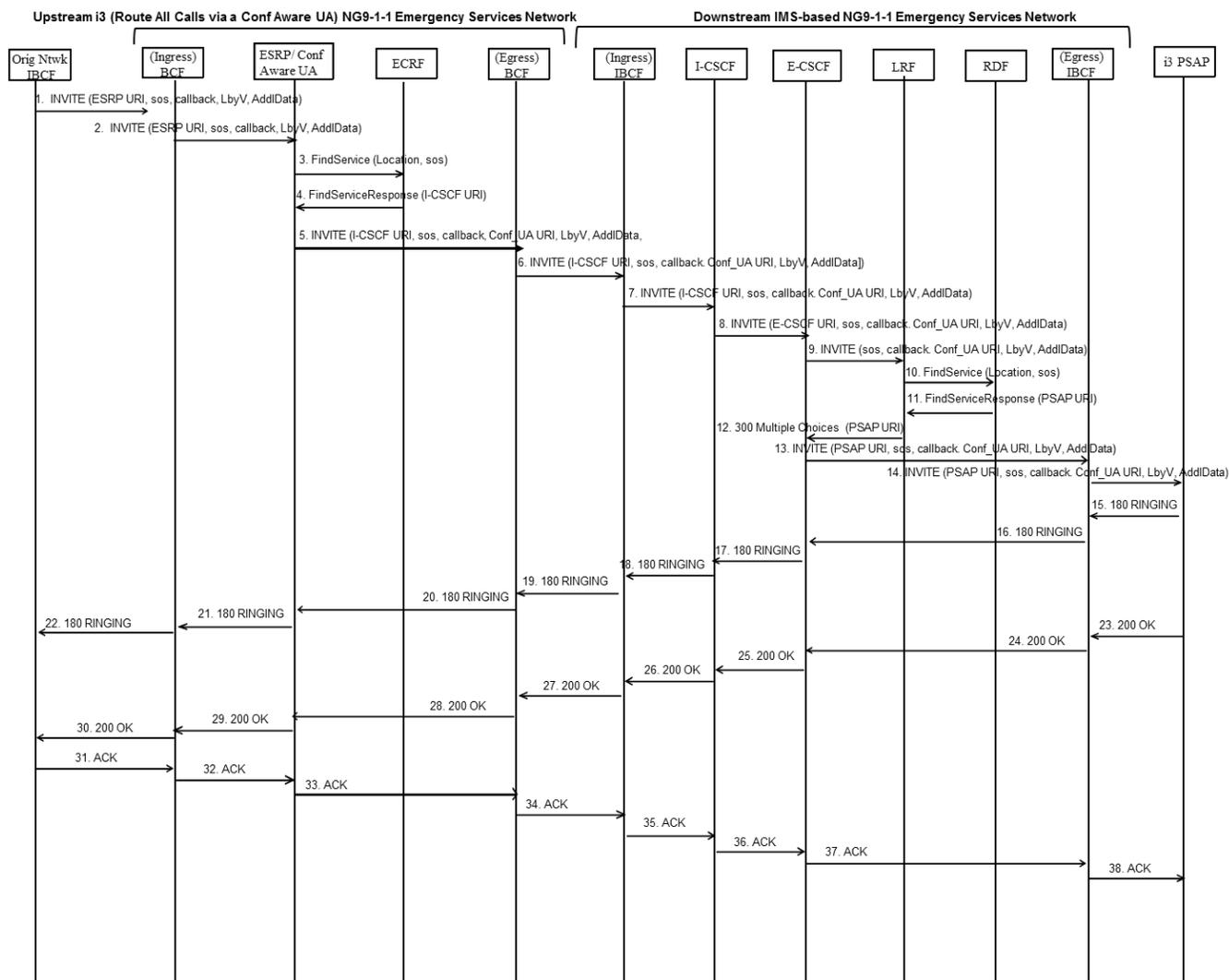


Figure 8.8: Initial Call – Upstream i3 (“Route All Calls via a Conference Aware UA”) NG9-1-1 Emergency Services Network to Downstream IMS-based NG9-1-1 Emergency Services Network

- Step 1.** The IBCF in the originating network sends an emergency call origination to an (ingress) BCF in the i3 NG9-1-1 Emergency Services Network. The SIP INVITE message includes a Route header that contains the ESRP/Conference Aware UA URI, an emergency services service URN (urn:service:sos), callback information, LbyV, and Additional Data (by value).
- Step 2.** The ingress BCF forwards the received INVITE message to the ESRP/Conference Aware UA.
- Step 3.** The ESRP component of the ESRP/Conference Aware UA queries the ECRF using the location information received in the body of the received SIP INVITE message and the emergency service URN (urn:service:sos).
- Step 4.** The ECRF returns a Route URI. In this example, the Route URI is associated with an I-CSCF in a Downstream IMS-based NG9-1-1 Emergency Services Network.
- Step 5.** The Conference Aware UA component of the ESRP/Conference Aware UA generates an outgoing SIP INVITE message, using the information received from the ECRF as well as information received in the initial SIP INVITE message, and forwards it to the egress BCF. The SIP INVITE message contains the Route URI of the I-CSCF in the Downstream IMS-based Emergency Services Network in the Route header, the sos service URN in the Request-URI and To header, the callback information in the From and P-Asserted-Identity headers, a Contact header that contains the URI of the ESRP/Conference Aware UA, the LbyV in the body (along

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with a cid in the Geolocation header and a Geolocation-Routing header set to “yes”), and Additional Data (by value) in the body (along with a cid in the Call-Info header).

NOTE: Since the initial emergency call is being forwarded to a downstream IMS-based Emergency Services Network rather than a PSAP that is served by the i3 NG9-1-1 Emergency Services Network, the SIP INVITE generated by the Conference Aware UA will not contain an ‘isfocus’ in the Contact header.

- Step 6.** The egress BCF forwards the SIP INVITE to the ingress IBCF in the IMS-based NG9-1-1 Emergency Services Network with all of the information specified in the last step.
- Step 7.** The ingress IBCF forwards the received INVITE message to the I-CSCF.
- Step 8.** The I-CSCF forwards the SIP INVITE to the pre-configured E-CSCF. The SIP INVITE message sent to the E-CSCF by the I-CSCF contains the E-CSCF URI in the Route header, and includes the callback information, “sos” service URN, LbyV, and Additional Data (by value), as received in the incoming SIP INVITE message.
- Step 9.** The E-CSCF forwards the SIP INVITE to the LRF.
- Step 10.** LRF queries the RDF using the location information received in the body of the received SIP INVITE message and the emergency service URN (urn:service:sos).
- Step 11.** The RDF returns a Route URI. In this example, the Route URI (PSAP URI) is associated with an i3 PSAP.
- Step 12.** The LRF redirects the call back to the E-CSCF, passing the PSAP URI.
- Step 13.** The E-CSCF generates an outgoing SIP INVITE message, using the information received from the LRF as well as information received in the initial SIP INVITE message, and forwards it to the (egress) IBCF. The SIP INVITE message contains the Route URI of the PSAP in the Route header, the sos service URN in the Request-URI and To header, the callback information in the From and P-Asserted-Identity headers, a Contact header that contains the URI of the ESRP/Conference Aware UA, the LbyV in the body (along with a cid in the Geolocation header and a Geolocation-Routing header set to “yes”), and Additional Data (by value) in the body (along with a cid in the Call-Info header).
- Step 14.** The egress IBCF forwards the SIP INVITE to the PSAP with all of the information specified in the last step.
- Step 15.** The i3 PSAP sends 180 RINGING back to the egress IBCF.
- Step 16.** The egress IBCF sends 180 RINGING to the E-CSCF.
- Step 17.** The E-CSCF sends 180 RINGING to the I-CSCF.
- Step 18.** The I-CSCF sends 180 RINGING back to the ingress IBCF.
- Step 19.** The ingress IBCF sends 180 RINGING to the egress BCF.
- Step 20.** The egress BCF sends 180 RINGING to the ESRP.
- Step 21.** The ESRP sends 180 RINGING to the ingress BCF.
- Step 22.** The ingress BCF sends 180 RINGING to the Originating Network IBCF.
- Step 23.** The i3 PSAP returns 200 OK to the egress IBCF.
- Step 24.** The egress IBCF sends 200 OK to the E-CSCF.
- Step 25.** The E-CSCF sends 200 OK to the I-CSCF.
- Step 26.** The I-CSCF sends 200 OK to the ingress IBCF.
- Step 27.** The ingress IBCF sends a 200 OK to egress BCF.
- Step 28.** The egress BCF sends a 200 OK to the ESRP.
- Step 29.** The ESRP sends 200 OK to the ingress BCF.
- Step 30.** The ingress BCF sends 200 OK to the Originating Network IBCF.

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- Step 31.** The originating network sends ACK to the ingress BCF.
- Step 32.** The ingress BCF sends the ACK to the ESRP.
- Step 33.** The ESRP sends the ACK to the egress BCF.
- Step 34.** The egress BCF sends the ACK to the ingress IBCF.
- Step 35.** The ingress IBCF sends the ACK to the I-CSCF.
- Step 36.** The I-CSCF sends the ACK to the E-CSCF.
- Step 37.** The E-CSCF sends the ACK to the egress IBCF.
- Step 38.** The egress IBCF sends the ACK to the i3 PSAP.

8.7.1 Alternate Call Flow Scenarios

Location by Reference

Instead of location-by-value being provided in the initial SIP INVITE, the SIP INVITE may contain location-by-reference with a location URI specified in the Geolocation header. For this scenario, the ESRP in the Upstream i3 NG9-1-1 Emergency Services Network would have to query the element identified in the location URI for location and use that location to determine the route. When the call is delivered to the Downstream IMS-based NG9-1-1 Emergency Services Network, the LRF in that network will have to query the same element for location and use that location to determine the route toward the PSAP. When the call is delivered to the i3 PSAP, the i3 PSAP will use the location URI to obtain location information to support dispatch.

Additional Data by Reference

If Additional Data is provided “by reference” (i.e., with a dereferencing URI in the Call-Info header) instead of “by value” in the initial SIP INVITE, a dereference request will only be initiated by the ESRP in the Upstream i3 NG9-1-1 Emergency Services Network or the LRF in the Downstream IMS-based NG9-1-1 Emergency Services Network if Additional Data is to be used for policy-based routing. The reference URI will be forwarded to the i3 PSAP and the i3 PSAP will use it to send a dereference request to obtain Additional Data “by value”.

Legacy Network Gateway in Upstream IMS-based NG9-1-1 Emergency Services Network

Instead of an IP-based originating network, the originating network could be a legacy network. In that case, the signaling from the legacy originating network would enter an LNG. The LNG will obtain location information and additional data and will format that information appropriately for delivery to the Upstream i3 NG9-1-1 Emergency Services Network (i.e., in the PIDF-LO and/or Additional Data structures). (See Clause 7.1 of NENA-STA-010.2 [Ref 23].) The call flow will then proceed as described in Step 1 of Figure 8.8, with the LNG delivering the call to the ingress BCF.

Legacy PSAP Served by the Downstream IMS-based NG9-1-1 Emergency Services Network

Instead of the Downstream IMS-based NG9-1-1 Emergency Services Network delivering the call to an i3 PSAP it may deliver the call to a legacy PSAP via an LPG. In that case, the INVITE in Step 14 of Figure 8.8 will be sent to an LPG. The LPG will create a pANI and format the outgoing signaling as appropriate for that legacy PSAP. When the call is delivered to the legacy PSAP, it will query the LPG for location information, call back number and additional information. (See Clause 7.2 of NENA-STA-010.2 [Ref 23] for further details.)

8.8 Conference – IMS-based NG9-1-1 Emergency Services Network to IMS-based NG9-1-1 Emergency Services Network

This scenario illustrates conferencing between a PSAP served by the Upstream IMS-based NG9-1-1 Emergency Services Network and a PSAP served by a Downstream IMS-based NG9-1-1 Emergency Services Network.

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The flow depicted in Figure 8.9 is based upon Figure 8-19 in ATIS-0500032 [Ref 26] and illustrates the mechanism by which an i3 PSAP creates a conference at a conferencing AS. This call flow assumes that upon receiving an emergency session request (i.e., a session request in which the Request-URI contains a service URN in the “sos” tree [e.g., “urn:service:sos”]), the originating network-facing IBCF will determine whether or not the incoming SIP INVITE message includes a Supported header containing the Replaces option-tag. If it does not, the IBCF will act as a Back-to-Back User Agent (B2BUA) and include a Supported header containing the Replaces option-tag in the outgoing SIP INVITE message that it sends to the I-CSCF. Normal call processing will be applied to the emergency call as it progresses through the IMS-based NG9-1-1 Emergency Services Network and is delivered to a Primary i3 PSAP that is served by that network.

In this example, the (Primary) i3 PSAP determines that the call must be transferred and creates a conference to support the transfer of the emergency call. This call flow assumes that the calling device does not support the Replaces header. In addition, this call flow assumes that all signaling to/from the conferencing AS/MRFC to establish the initial conference between the Primary PSAP and the conferencing AS/MRFC flows through the I-CSCF.

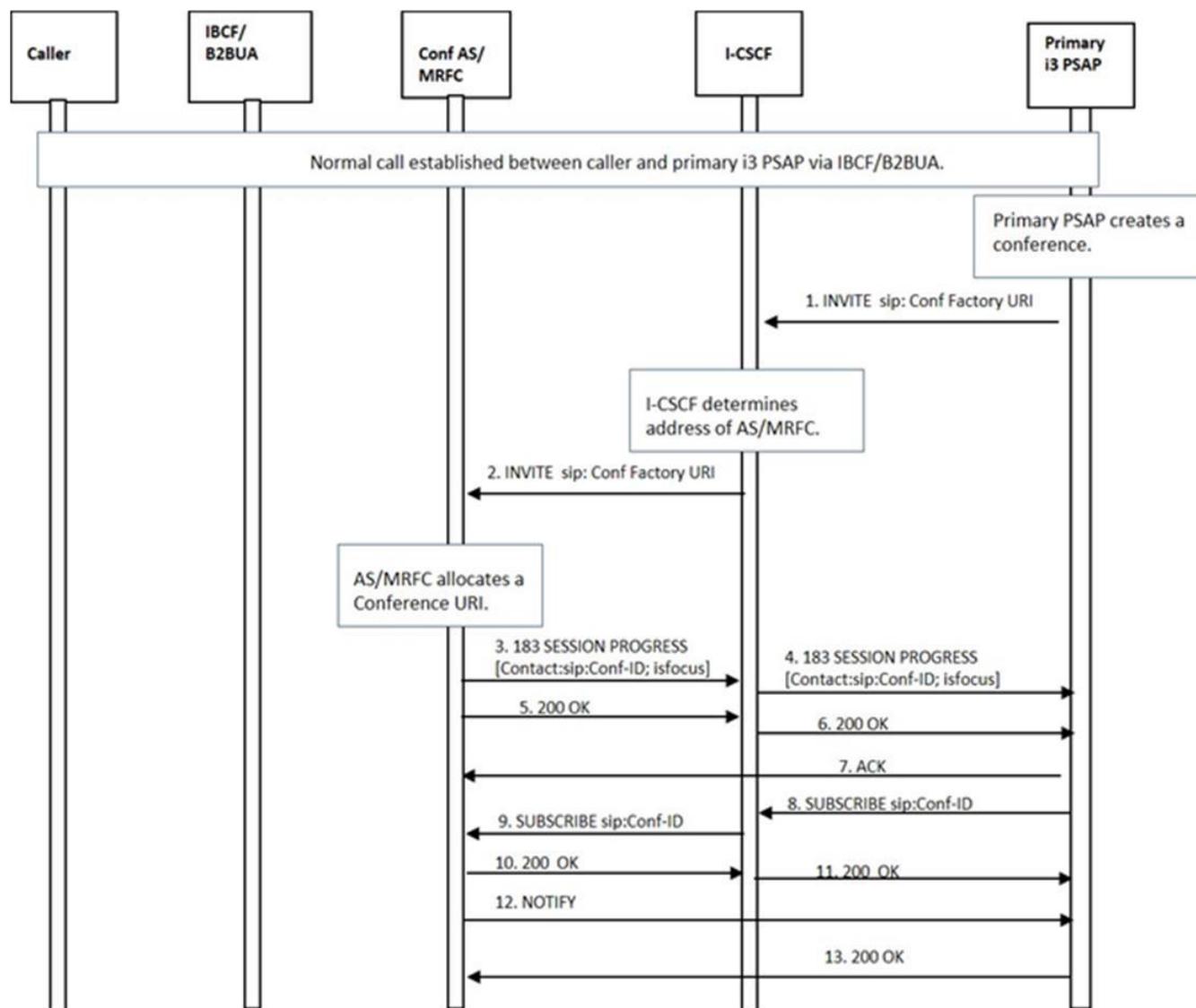


Figure 8.9: PSAP in Upstream IMS-based Emergency Services Network Establishes Conference with Conferencing AS/MRFC (ATIS-0500032 Figure 8-19)

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- Step 1.** The Primary PSAP determines that it needs to transfer an emergency call and therefore must create a conference using an AS/MRFC in the IMS-based NG9-1-1 Emergency Services Network. The Primary i3 PSAP creates the conference by first sending an INVITE (via an IBCF [not shown]) to an I-CSCF in the IMS-based NG9-1-1 Emergency Services Network, using a conference factory URI that is known by/provisioned at the Primary i3 PSAP. The SIP INVITE message will include a Resource Priority Header set to “esnet.1” to indicate that the session request is associated with the transfer of an emergency call.

The I-CSCF resolves the conference factory URI and determines the address of the conferencing AS/MRFC.

- Step 2.** The I-CSCF forwards the SIP INVITE message to the conferencing AS/MRFC. The I-CSCF does not add itself to the Record-Route header since it does not need to remain in the signaling path for subsequent requests.

The conferencing AS/MRFC allocates a conference URI, based on local information, information gained from the conference-factory URI, and other information received in SIP signaling.

- Step 3.** The conferencing AS/MRFC responds to the INVITE by returning a 183 SESSION PROGRESS message to the I-CSCF. The Contact header contains the conference URI for the conference allocated at the AS/MRFC and the isfocus feature parameter.
- Step 4.** The I-CSCF passes the 183 SESSION PROGRESS message (via an IBCF [not shown]) to the Primary i3 PSAP.
- Step 5.** The conferencing AS/MRFC then returns a 200 OK message to the I-CSCF, to establish a session with the Primary i3 PSAP.
- Step 6.** The I-CSCF sends a 200 OK message (via an IBCF [not shown]) to the Primary i3 PSAP.
- Step 7.** The Primary i3 PSAP returns an ACK message to the conferencing AS/MRFC (via an IBCF [not shown]) in response to the 200 OK message.

A session is established between the Primary i3 PSAP and the conferencing AS/MRFC. Note that the media session between the IBCF/B2BUA and the Primary i3 PSAP still exists at this time.

- Step 8.** The Primary i3 PSAP subscribes to the conference associated with the URI obtained from the Contact header provided by the conferencing AS/MRFC in the 180 SESSION PROGRESS message by sending a SIP SUBSCRIBE message containing the Conference ID via an IBCF (not shown) to the I-CSCF.
- Step 9.** The I-CSCF sends the SIP SUBSCRIBE message to the conferencing AS/MRFC. The I-CSCF does not add itself to the Record-Route header since it does not need to remain in the signaling path for subsequent requests.
- Step 10.** The conferencing AS/MRFC acknowledges the subscription request by sending a 200 OK message to the I-CSCF.
- Step 11.** The I-CSCF passes the 200 OK message back to the Primary i3 PSAP via an IBCF (not shown).
- Step 12.** The conferencing AS/MRFC then sends a NOTIFY message to the Primary i3 PSAP via an IBCF (not shown) to provide subscription status information.
- Step 13.** The i3 PSAP responds by returning a 200 OK message via an IBCF (not shown) to the AS/MRFC.

Having established the conference, the Primary i3 PSAP in the Upstream IMS-based Emergency Services Network asks the conferencing AS/MRFC to invite the IBCF/B2BUA (proxy for the caller) to the conference as shown in Figure 8.10. As specified above, this flow assumes that the calling device does not support the Replaces header and that the PSAP-facing IBCF (not shown) is operating as a proxy.

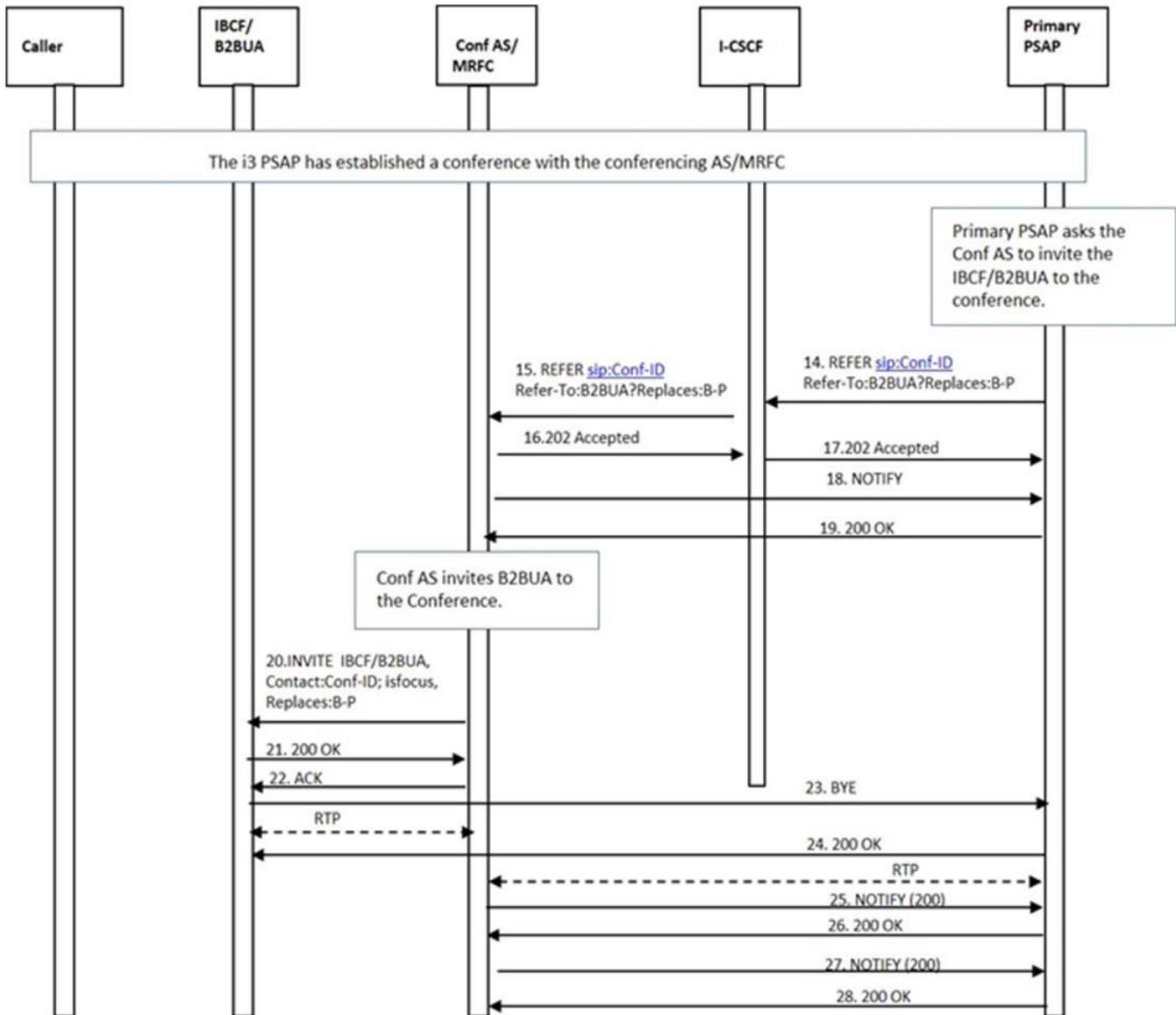


Figure 8.10: i3 PSAP in Upstream IMS-based Emergency Services Network Requests that IBCF/B2BUA be Invited to the Conference (ATIS-0500032 Figure 8-20)

- Step 14.** The Primary i3 PSAP sends a REFER method to the I-CSCF (via an IBCF [not shown]).
- Step 15.** The I-CSCF passes the REFER method to the conferencing AS/MRFC. The I-CSCF does not add itself to the Record-Route header since it does not need to remain in the signaling path for subsequent requests. The REFER method requests that the conferencing AS/MRFC invite the IBCF/B2BUA to the conference. The REFER method contains an escaped Replaces header field in the URI included in the Refer-To header field.
- Step 16.** The conferencing AS/MRFC returns a 202 Accepted message to the I-CSCF.
- Step 17.** The I-CSCF passes the 202 Accepted message (via an IBCF [not shown]) to the Primary i3 PSAP.
- Step 18.** The conferencing AS/MRFC then returns a NOTIFY message (via an IBCF [not shown]) to the Primary i3 PSAP, indicating the subscription state of the REFER request (i.e., active).
- Step 19.** The Primary i3 PSAP returns a 200 OK message (via an IBCF [not shown]) in response to the NOTIFY message.

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- Step 20.** The conferencing AS/MRFC invites the IBCF/B2BUA to the conference by sending it an INVITE method containing the Conf-ID and a Replaces header that references the leg between the IBCF/B2BUA and the Primary PSAP.
- Step 21.** The IBCF/B2BUA accepts the invitation by returning a 200 OK message to the conferencing AS/MRFC.
- Step 22.** The conferencing AS/MRFC acknowledges receipt of the 200 OK message by returning an ACK.

A session is established between the IBCF/B2BUA and the conferencing AS/MRFC. Note that the media session between the IBCF/B2BUA and the Primary i3 PSAP still exists at this time. Note also that the media session between the caller and the IBCF/B2BUA is undisturbed.

- Step 23.** The IBCF/B2BUA terminates the session with the Primary i3 PSAP by sending a BYE message (via an IBCF [not shown], following the signaling path established by the INVITE request associated with the original emergency session) to the Primary i3 PSAP.

At this point, the IBCF/B2BUA switches the media from the session with the Primary i3 PSAP to the session with the conferencing AS/MRFC.

- Step 24.** The Primary i3 PSAP responds by returning a 200 OK message (via an IBCF [not shown]).

At this point, the Primary i3 PSAP switches the media to the session with the conferencing AS/MRFC and the session between the IBCF/B2BUA and the Primary PSAP is terminated.

- Step 25.** The conferencing AS/MRFC sends a NOTIFY message to the Primary i3 PSAP (via an IBCF [not shown]) to provide updated status of the subscription associated with the REFER request.
- Step 26.** The Primary i3 PSAP responds by returning a 200 OK message (via an IBCF [not shown]).
- Step 27.** The conferencing AS/MRFC sends a NOTIFY message to the Primary i3 PSAP (via an IBCF [not shown]) to provide updated status of the subscription associated with the REFER request.
- Step 28.** The Primary i3 PSAP responds by returning a 200 OK message to the conferencing AS/MRFC (via an IBCF [not shown]).

Having invited the IBCF/B2BUA (the proxy for the caller) to the conference, the i3 PSAP served by an Upstream IMS-based Emergency Services Network then requests that the conferencing AS/MRFC invite the transfer-to PSAP (referred to in this example as “Sec-PSAP”) which is served by the Downstream IMS-based NG9-1-1 Emergency Services Network to the conference, using the mechanisms defined in RFC 4579 [Ref 18], as illustrated in Figure 8.11 and Figure 8.12. When a Primary i3 PSAP handles a call, it develops information about the call that must be passed to subsequent PSAPs, dispatchers, and/or responders. This information is included in an Additional Data structure referred to as an Emergency Incident Data Document (EIDD). When, in the process of transferring an emergency call, an i3 PSAP requests that the conferencing AS invite the transfer-to PSAP to the conference, the Primary i3 PSAP will include a reference to an EIDD in the request it sends to the conferencing AS. The AS includes this reference in the Call-Info header of the SIP INVITE that it sends toward the transfer-to PSAP. The transfer-to PSAP uses the EIDD reference URI to query the Primary PSAP for the EIDD.

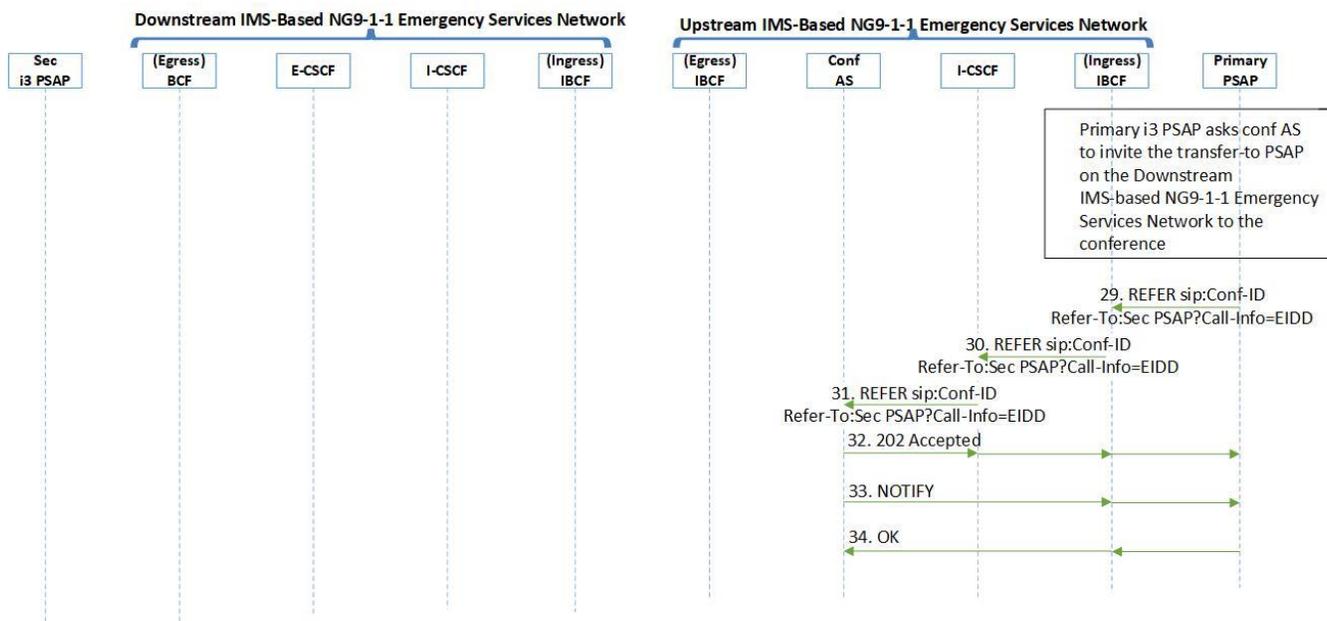


Figure 8.11: i3 PSAP Requests that a transfer-to i3 PSAP be Invited to the Conference (ATIS-0500032 Figure 8-21 – Modified-1)

- Step 29.** The Primary i3 PSAP sends a REFER method to the IBCF. The REFER method requests that the conferencing AS/MRFC invite the transfer-to i3 PSAP in the Downstream IMS-based NG9-1-1 Emergency Services Network to the conference. The REFER method contains the Conf-ID and a Refer-To header that contains the URI of the transfer-to i3 PSAP. The REFER method also contains an escaped Call-Info header field containing a reference URI that points to the EIDD data structure and a purpose parameter of “eidd”.
- Step 30.** The IBCF sends the REFER to the I-CSCF.
- Step 31.** The I-CSCF passes the REFER method to the conferencing AS/MRFC. The I-CSCF does not add itself to the Record-Route header since it does not need to remain in the signaling path for subsequent requests.
- Step 32.** The conferencing AS/MRFC returns a 202 Accepted message to the Primary i3 PSAP via the I-CSCF and IBCF.
- Step 33.** The conferencing AS/MRFC then returns a NOTIFY message to the Primary PSAP (via an I-CSCF and IBCF), indicating that subscription state of the REFER request (i.e., active).
- Step 34.** The Primary PSAP sends an OK to the NOTIFY message.

At this point the conferencing AS invites the PSAP in the Downstream IMS-based Emergency Services Network to the conference (Figure 8.12).

The SIP INVITE at Step 35 will include (at a minimum) the following headers.

- sos in the Request Line
- To – 911@Domain
- From – bridge-id@domain
- Route URI that points to the well-known PSAP URI of the PSAP in Downstream IMS-based NG9-1-1 Emergency Services Network
- EIDD URI in a Call-Info header (to acquire location, callback number and additional data)
- Contact header – Conference ID with ISFOCUS
- History-Info denoting that this is a transfer.

- Other normal SIP INVITE headers (e.g. Via, Call-ID, etc.)

NOTE: The PAI (i.e. callback number) is not included in the INVITE. If it was provided in the initial call request, it will be contained within the EIDD.

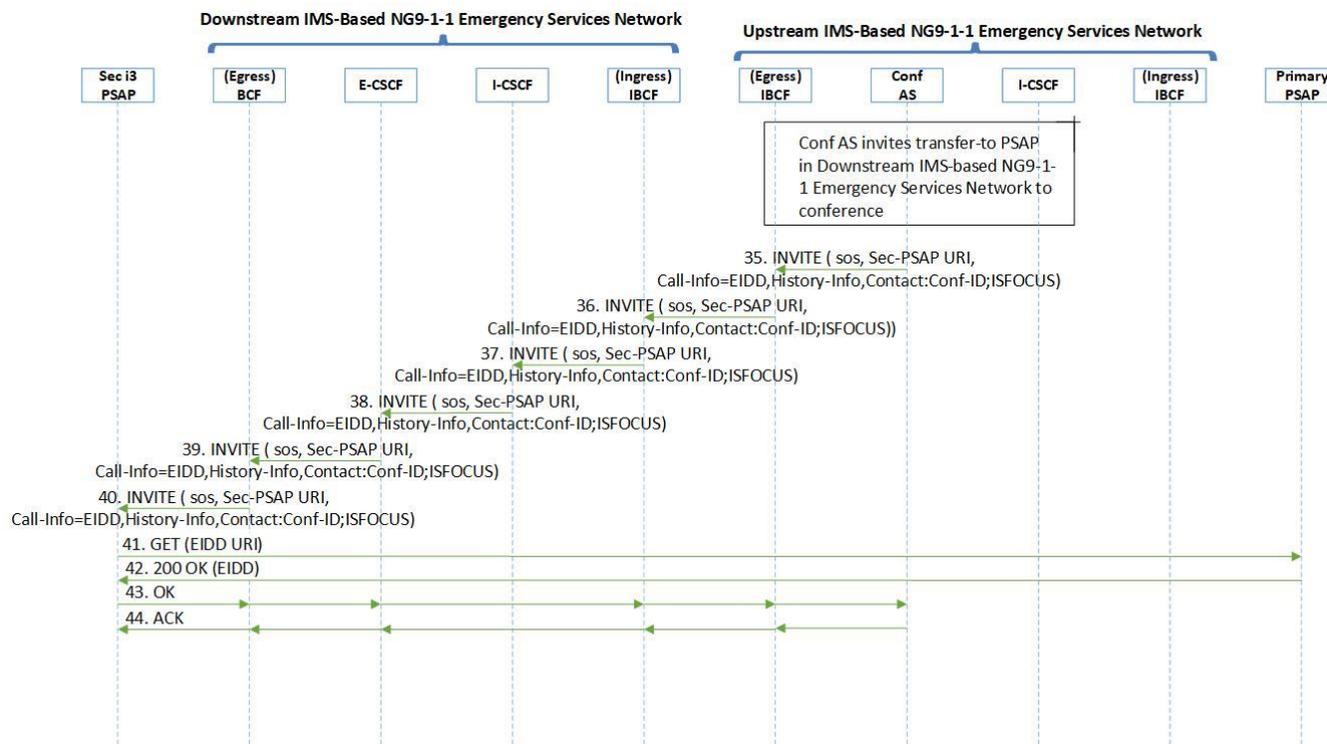


Figure 8.12: AS Invites a transfer-to i3 PSAP to the Conference (ATIS-0500032 Figure 8-21 - Modified-2)

- Step 35.** The conferencing AS/MRFC invites the transfer-to i3 PSAP to the conference by sending an INVITE method via an IBCF. The INVITE contains the Call-Info header field containing a reference URI that points to the EIDD data structure and a purpose parameter of “eid”. The SIP INVITE message also will include a History-Info header to indicate that the session request is associated with the transfer of an emergency call. The Conference ID will be in the Contact header indicating it is an ISFOCUS.
- Step 36.** The (egress) IBCF forwards the INVITE to the (ingress) IBCF of the Downstream IMS-based NG9-1-1 Emergency Services Network.
- Step 37.** The (ingress) IBCF forwards the INVITE to the ICSCF.
- Step 38.** The I-CSCF forwards the SIP INVITE to the pre-configured E-CSCF.
- Step 39.** The E-CSCF recognizes that this is a transferred call since the INVITE does not include location information, has a History-Info header and contains a Route header pointing to the destination PSAP. It then forwards the INVITE to the (egress) IBCF. (Note that if policy routing is to be applied to the call, the E-CSCF must first pass the INVITE to the LRF [not shown].)
- Step 40.** The (egress) IBCF delivers the call to the i3 PSAP.
- Step 41.** When the i3 PSAP receives the INVITE with the EIDD URI it sends a HTTP GET to the Primary PSAP.
- Step 42.** The Primary PSAP returns the EIDD.
- Step 43.** In parallel the Secondary PSAP sends a 200 OK through the SIP session.

Step 44. The AS responds with an ACK.

Conference Subscriptions and Notifications are not shown.

At this point the caller, Primary i3 PSAP, and transfer-to i3 PSAP are all participants in the conference.

8.8.1 Alternate Flows

Legacy PSAP Served by Downstream IMS-based NG9-1-1 Emergency Services Network

Instead of the Downstream IMS-based NG9-1-1 Emergency Services Network delivering the call to an i3 PSAP, it may deliver the call to a legacy PSAP via an LPG. In that case, the INVITE in Step 40 of Figure 8 goes to an LPG. The LPG dereferences the EIDD and reformats the information in an appropriate manner for the legacy PSAP. The LPG creates a pANI and formats the outgoing call setup signaling in a manner appropriate for that PSAP. When the call is delivered to the legacy PSAP, it will query the LPG for location information, callback number and additional information.

Legacy PSAP in Upstream IMS-based NG9-1-1 Emergency Services Network

Instead of an i3 PSAP initiating the transfer, a legacy PSAP could originate it. In that case, the transfer is initiated through an LPG. So instead of the PSAP setting up the conference by interacting with the conferencing AS, the LPG would interact with the bridge to set up the conference and refer the Secondary PSAP in the Downstream IMS-based NG9-1-1 Emergency Services Network to the conference.

8.9 Conference – Legacy Emergency Services Network to IMS-based NG9-1-1 Emergency Services Network

The scenario in Figure 8.13 illustrates a transfer initiated by a PSAP served by the Upstream Legacy Emergency Services Network to a PSAP served by a Downstream IMS-based NG9-1-1 Emergency Services Network. The SR recognizes that the transfer-to PSAP is served by a foreign network (i.e., Downstream IMS-based NG9-1-1 Emergency Services Network) and initiates a Tandem to Tandem connection to the LSRG. The LSRG obtains the ALI information and formats location and additional data appropriate for the Downstream IMS-based NG9-1-1 Emergency Services Network and uses it to populate an EIDD. The call is then destination-routed to the PSAP.

The SS7 signaling from the SR to the LSRG (Step 2) should follow the Direct Routing/Transfer at 2nd Tandem method as defined in NENA 03-003. The IAM from the SR to the LSRG will contain the following information:

- *CallingPartyNumber* – The callback number of the original 9-1-1 caller (as received by the Selective Router)
- *CalledPartyNumber* – A 10-digit telephone number corresponding to the transfer-to PSAP in the NG9-1-1 Emergency Services Network.

For a wireline call, the INVITE from the LSRG to the ingress IBCF, at a minimum, will contain the following headers:

- A Request URI containing a service urn, such as urn:ena:service:sos
- A Route Header that contains the 10-digit number/address associated with the target PSAP served by the Downstream IMS-based NG9-1-1 Emergency Services Network (expressed as a URI)
- From representing the callback number
- A To header that contains the 10-digit number/address associated with the transfer-to PSAP, formatted as a URI
- P-Asserted-Identity representing the callback number
- 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 a URI associated with the LSRG
- History-Info indicating this was a transfer
- A Call-Info header that contains a URI which, when dereferenced, can be used to access an EIDD.

- Other normal SIP INVITE headers (e.g., Via, Call-ID, etc.)

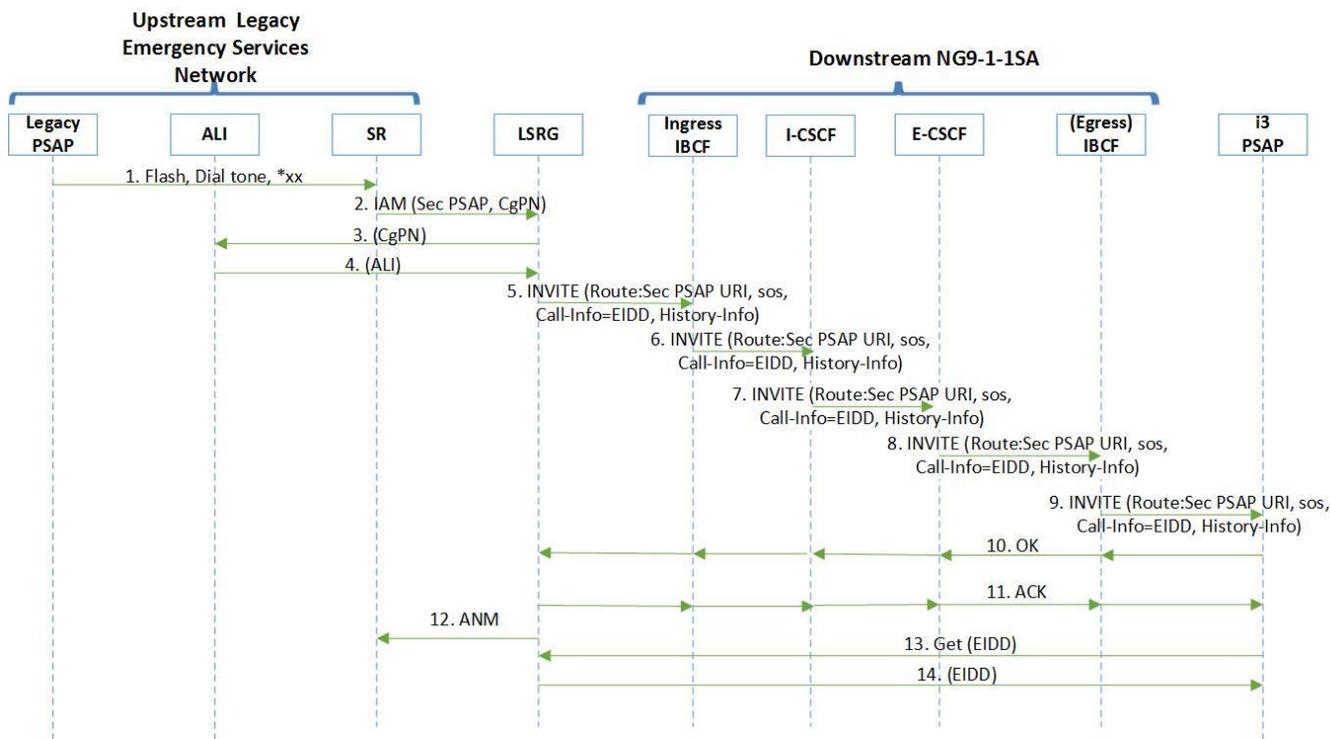


Figure 8.13: Conference – Legacy Emergency Services Network to IMS-based NG9-1-1 Emergency Services Network

- Step 1.** The Primary PSAP determines that it needs to transfer an emergency call and therefore sends a “star” code to the SR indicating that it wants to selectively transfer the call. (Note the PSAP may indicate a manual transfer in which case it provides the directory number of the transfer-to PSAP.)
- Step 2.** The SR accesses internal tables and determines that the outgoing route is associated with the Tandem to Tandem trunks to the LSRG. The SR initiates an IAM message to the LSRG including the directory number of the destination PSAP and the Calling Party Number.
- Step 3.** The LSRG queries the ALI with the content of the Calling Party Number it received in the IAM message.
- Step 4.** The ALI returns a fixed formatted message containing legacy ALI location information and other data.
- Step 5.** The LSRG reformats the information returned by the ALI system into an EIDD. It puts a reference URI to the EIDD in the Call-Info header. This can be used by the transfer-to PSAP to retrieve a PIDF-LO and other Additional Data. The LSRG creates an INVITE with Route headers indicating the destination (transferred to) PSAP and forwards the INVITE.
- Step 6.** The (ingress) BCF forwards the INVITE to the I-CSCF.
- Step 7.** The I-CSCF forwards the INVITE to the E-CSCF.
- Step 8.** The E-CSCF, recognizing that there is a Route header for the destination PSAP, does not perform location-based routing, but forwards the INVITE toward the destination PSAP via an (egress) IBCF. Note that policy routing may be performed, and if so, will require that the E-CSCF pass the INVITE to the LRF (not shown).
- Step 9.** The IBCF forwards the call to the PSAP.

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- Step 10.** The OK is returned back to the LSRG through the SIP session path.
- Step 11.** The LSRG returns an ACK through the SIP session path.
- Step 12.** The LSRG returns an SS7 ANM to the SR and media is established.
- Step 13.** The PSAP sends a request to dereference the EIDD.
- Step 14.** The LSRG returns the EIDD.

8.10 Conference – IMS-based NG9-1-1 Emergency Services Network to Legacy Emergency Services Network

Figure 8.9 and Figure 8.10 illustrate how a Primary PSAP served by an NG9-1-1 Emergency Services Network creates a conference and invites the caller to the conference. Figure 8.14 picks up there and shows how a PSAP served by a legacy Emergency Services Network is added to the conference. The Conference AS sends an INVITE toward the LSRG, identifying the PSAP in the legacy Emergency Services Network as the destination for the transferred call. The LSRG allocates a pANI and converts the data received in the SIP INVITE to a format that can be used by the legacy Emergency Services Network. It initiates a Tandem to Tandem connection with the SR and the SR forwards the call to the destination PSAP along with the pANI. The PSAP queries the ALI system using the pANI and the ALI system steers the request to the LSRG. The LSRG returns the location information and potentially additional data in the legacy format.

The SS7 signaling from the LSRG to the SR should follow the Direct Routing/Transfer at 2nd Tandem method as defined in NENA 03-003 [Ref 102]. The IAM from the LSRG to the SR will contain the following information:

- *CallingPartyNumber* – The pANI defined by the LSRG.
- *CalledPartyNumber* - A digit sequence which will cause the E9-1-1 Tandem (SR) to route the call to the correct destination. Typically, this is a 7 or 10-digit telephone number corresponding to the main number of the destination PSAP.

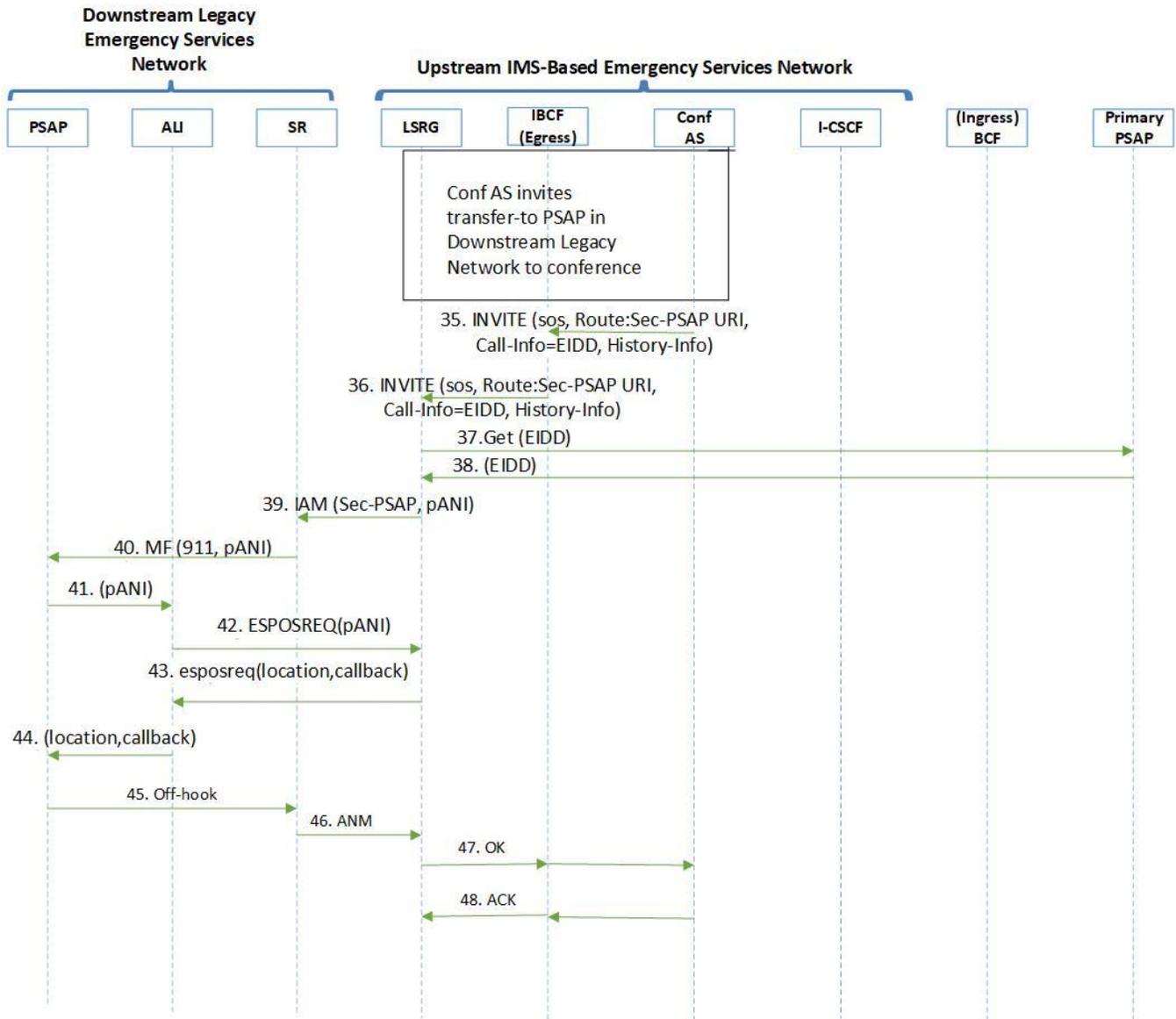


Figure 8.14: Conference – IMS-based NG9-1-1 Emergency Services Network to Legacy Emergency Services Network

- Step 35.** The conferencing AS/MRFC invites the transfer-to PSAP to the conference by sending an INVITE method to the (egress) IBCF. The INVITE contains a Route header with the transfer-to PSAP URI, the Call-Info header field containing a reference URI that points to the EIDD data structure and a purpose parameter of “eid”. The SIP INVITE message will include a History-Info header to indicate that the session request is associated with the transfer of an emergency call.
- Step 36.** The (egress) IBCF forwards the INVITE to the LSRG.
- Step 37.** The LSRG requests the EIDD from the originating PSAP.
- Step 38.** The PSAP returns the EIDD and the LSRG reformats the data to a legacy format and creates a pANI that can be used to retrieve the information.
- Step 39.** The LSRG sends a SS7 IAM message to the SR with Called Party Number of the transfer-to PSAP and the pANI created by the LSRG in the Calling Party Number parameter.

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- Step 40.** The SR delivers the call (including the pANI) to the PSAP using the appropriate MF signaling interface. (Note: additional CAMA signaling such as Wink are not shown. Also, the potential of providing early media is not shown.)
- Step 41.** The PSAP sends an ALI request to the ALI system that includes the pANI.
- Step 42.** The ALI system steers the request to the LSRG.
- Step 43.** The LSRG returns location, callback and other data to the ALI system formatted appropriately.
- Step 44.** The ALI system returns location, callback and other data to the PSAP using an appropriate legacy format.
- Step 45.** The PSAP goes off hook to accept the call.
- Step 46.** The SR sends an SS7 Answer message to the LSRG.
- Step 47.** The LSRG sends a SIP 200 OK to the Conference AS through the SIP session path.
- Step 48.** The Conference AS sends an ACK and media is established.

Conference Subscriptions and Notifications are not shown.

9 Stage 3

This clause defines Stage 3 procedures for the network elements within an IMS-based NG9-1-1 Emergency Services Network. This clause refers to 3GPP TS 24.229 [Ref 2] and describes the use of the elements within an IMS-based NG9-1-1 Emergency Services Network and their use in supporting interconnection with other emergency service networks. This clause also illustrates header usage and examples.

9.1 Procedures and Header Usage for the Emergency Call Session Control Function (E-CSCF)

For North America, the E-CSCF shall follow the procedures in Clauses 4 and 5.11.1 of 3GPP TS 24.229 [Ref 2] with the following clarifications:

1. The E-CSCF receives all SIP requests from the I-CSCF. The Proxy-Call Session Control Function (P-CSCF) is not applicable in this architecture.
2. The E-CSCF shall always query the LRF to obtain routing instructions (i.e., the next-hop URI) for initial or transferred emergency calls received from interconnected originating or emergency services networks. The E-CSCF will route initial and transferred emergency calls based on the URI in the Contact header of the 300 Multiple Choices message received from the LRF.
3. The E-CSCF connects to NENA NG9-1-1 PSAPs served by the IMS-based NG9-1-1 Emergency Services Network in which the E-CSCF resides via an (egress) IBCF. The E-CSCF connects to legacy PSAPs served by the IMS-based NG9-1-1 Emergency Services Network in which the E-CSCF resides via an IBCF and an LPG. The E-CSCF connects to other emergency services networks for delivery of initial and transferred calls via an (egress) IBCF.
4. Emergency dialogs requesting privacy, as noted in 3GPP TS 22.101 [Ref 3], shall not be supported in North America.

Due to the placement of the E-CSCF in the IMS-based NG9-1-1 Emergency Services Network, not all of the procedures contained in Clause 5.11.2 of 3GPP TS 24.229 (UE originating case) are applicable. Only the following procedures apply with the clarifications provided below:

1. (5.11.2 step 1A) The E-CSCF will remove its own SIP URI from the topmost Route header field.

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2. (5.11.2 step 1D) Since an LRF is to be used for routing an emergency call, the E-CSCF will forward the request to the LRF as defined in subclause 5.11.3 of 3GPP TS 24.229. It will pass all headers received from the I-CSCF.
3. When the 300 response is received (as described in Clause 5.11.3 of 3GPP TS 24.229), the E-CSCF will map Contact header parameters as specified below.
4. For North America, the E-CSCF will forward a SIP INVITE destined for an NG9-1-1 PSAP or a legacy PSAP served by the same IMS-based NG9-1-1 Emergency Services Network as the one in which the E-CSCF resides via an IBCF based on the Route URI received in the Contact header of the 300 Multiple Choices message returned by the LRF, as described below.
5. An E-CSCF operating in an emergency services network in North America may, as an implementation option, create a Record-Route header field containing its own SIP URI.

NOTE: Operators may wish to consider whether the optional SUBSCRIBE/NOTIFY mechanism between the E-CSCF and the LRF will be implemented, as well as the transfer mechanism supported, in determining whether an E-CSCF operating in their emergency services network creates a Record-Route header field containing its own SIP URI.

6. (5.11.2 step 10) If the request is an INVITE request, the E-CSCF shall save Contact, Command Sequence (CSeq), and Record-Route header field values received in the request such that the E-CSCF is able to release the session if needed.
7. (5.11.2 step 13) The E-CSCF shall route the request based on SIP routing procedures.

The E-CSCF shall not create the P-Charging-Vector or P-Charging-Address headers but shall pass any P-Charging-Vector or P-Charging-Address headers received in the incoming SIP INVITE. If the P-Charging-Vector header is included in the incoming SIP INVITE it is expected that it identifies the carrier.

For North America, the E-CSCF shall follow the procedures in 3GPP TS 24.229 Clause 5.11.3, Use of LRF, for initial emergency requests with the following clarifications:

- The E-CSCF shall pass to the LRF the initial request for a dialog containing an emergency service URN that it received from the I-CSCF. The Request URI of urn:service:sos will be received from the I-CSCF and will not be modified by the E-CSCF. The E-CSCF shall also pass transferred emergency requests received from an I-CSCF to the LRF. A transferred emergency request will contain a Route header and an EIDD and may contain a service URN in the NENA namespace in the Request URI. As for initial requests, the E-CSCF will pass the service URN, unchanged, to the LRF.
- The E-CSCF will not insert a P-Charging-Vector header field.
- When the E-CSCF receives any 3xx response to such a request, the E-CSCF shall select a Contact header and parse it as described below and will follow the procedures above and not those in Clause 5.11.2 of 3GPP TS 24.229.
- The E-CSCF shall also follow the procedures adopted in Clause 5.11.3 of 3GPP TS 24.229 with the following clarifications:
 - When the E-CSCF receives a SIP 300 Multiple Choices message from an LRF, it shall populate the Contact header URI in the topmost entry in the Route header of the outgoing SIP INVITE as described in Clause 9.1.1.
 - As described in Clause 5.11.3 of 3GPP TS 24.229, if the E-CSCF does not receive a SIP 300 Multiple Choices in response to an initial request sent to the LRF within an operator settable timeout, the E-CSCF shall use a default URI value (configured in the E-CSCF) in the topmost entry in the Route header of the outgoing SIP INVITE message. If the E-CSCF does not receive a SIP 300 Multiple Choices in response to a SIP INVITE message associated with a transferred emergency request, the E-CSCF shall use the URI in the Route header of the INVITE message received from the I-CSCF to route the call forward.

9.1.1 Header Usage

This clause denotes specific use of headers in this standard in compliance with the respective RFCs. Only pertinent headers are discussed. Any SIP headers that are received from the I-CSCF and are not modified in this clause should be passed unmodified.

Parsing of the 300 Multiple Choices Contact Header

The Contact header in the 300 Multiple Choices response shall contain a Route URI that designates a legacy PSAP (i.e., a PSAP URI that resolves at a Legacy PSAP Gateway or Legacy Selective Router Gateway), a NENA NG9-1-1 PSAP, an ESRP in an interconnected i3 ESInet, or an I-CSCF in an interconnected IMS-based NG9-1-1 Emergency Services Network.

Request Line

On an outgoing initial SIP INVITE message sent toward a legacy PSAP, NENA NG9-1-1 PSAP, i3 ESInet or IMS-based NG9-1-1 Emergency Services Network, the E-CSCF shall copy the service URN received in the Request URI of the incoming SIP INVITE to the Request URI header of the outgoing SIP INVITE message.

Example:

```
INVITE urn:service:sos SIP/2.0
```

Route

The E-CSCF will create a Route header in the outgoing SIP INVITE message and will populate the Route header with the sip URI that was returned in the Contact header of the 300 Multiple Choices response.

Example:

```
Route:sip:psap@st.county.net
```

9.2 Procedures and Header Usage for the Location Retrieval Function (LRF)

The LRF procedures are defined in 3GPP TS 24.229 [Ref 2] Clauses 4, 5.11.3, and 5.12. For North America, the following clarifications apply:

9.2.1 Processing of Origination from i3-Compliant Originating Network or LNG

Initial emergency originations from i3-compliant originating networks or LNGs are expected to include a Geolocation header. When a Geolocation header is present in the SIP INVITE message received from the E-CSCF, then the following conditions apply:

- If the Geolocation header contains a “cid” that defines that the location is in the body of the request (i.e., LbyV), the LRF will use that location in subsequent processing.
- If the Geolocation header contains a location reference URI (i.e., LbyR), the LRF will retrieve the location via the D1 Reference Point and will use that location in subsequent processing.

Having obtained location information for the emergency call, the LRF uses that location information to query the RDF for routing information. The LRF will then return the routing information to the E-CSCF in the 300 Multiple Choices response.

If a Geolocation header is not present in the SIP INVITE message received from the E-CSCF, then the LRF will return a configured default Route URI to the E-CSCF in the 300 Multiple Choices response.

9.2.2 Using Incoming Signaling Information to Facilitate Error Handling

To facilitate error processing for calls that entered the IMS-based NG9-1-1 Emergency Services Network via an LNG, the LRF may use the trunk group (tgrp) and trunk group context parameters if populated by the LNG in the Contact header of the outgoing SIP INVITE message. If the tgrp and trunk-context parameters are included in the

incoming Contact header, and the LRF contains pre-provisioned error handling rules, the LRF may use those rules to provide routing instructions back to the E-CSCF. This allows the LRF to provide different error handling based upon the class of service associated with the SS7 trunk group. Alternatively, the LRF can use class of service information available in the Additional Data provided in the incoming SIP INVITE message as a basis for error handling.

9.2.3 Processing of Incoming Emergency Call from i3 ESNets, IMS-based NG9-1-1 Emergency Services Network or Legacy Selective Router Gateway

Initial emergency calls received from i3 ESNets, upstream IMS-based NG9-1-1 Emergency Services Networks, or Legacy Selective Router Gateways are expected to include a Geolocation header. When a Geolocation header is present in the SIP INVITE message received from the E-CSCF, then the following conditions apply:

- If the Geolocation header contains a “cid” that defines that the location is in the body of the request (i.e., LbyV), the LRF will use that location in subsequent processing.
- If the Geolocation header contains a location reference URI (i.e., LbyR), the LRF will retrieve the location via the D1 Reference Point or a Reference Point that is functionally equivalent to the D2 Reference point (i.e., D3), and will use that location in subsequent processing.

Having obtained location information for the emergency call, the LRF uses that location information to query the RDF for routing information. The LRF will then return the routing information to the E-CSCF in the 300 Multiple Choices response.

If a Geolocation header is not present in the SIP INVITE message associated with an initial emergency call received from the E-CSCF, then the LRF will return a configured default Route URI to the E-CSCF in the 300 Multiple Choices response.

When a transferred emergency call from an i3 ESNets, an upstream IMS-based NG9-1-1 Emergency Services Network, or a Legacy Selective Router Gateway is received by an LRF, the LRF will use the URI in the Route header to interrogate the Policy Routing Function. The LRF shall not perform location-based routing (i.e., by querying the RDF) on transferred emergency calls. If the Policy Routing Function results in a different Route URI than was provided in the incoming INVITE message, the LRF will return the new Route URI to the E-CSCF in the Contact header of the 300 Multiple Choices response. If the application of Policy Routing functionality to the transferred call does not result in a different Route URI, the LRF will return the Route URI received in the Route header of the SIP INVITE message in the Contact header of the 300 Multiple Choices response.

9.2.4 Header Usage

This clause discusses headers used in the SIP 300 Multiple Choices response to the E-CSCF.

Contact Header

The Contact header in the 300 Multiple Choices message from the LRF will contain: 1) the Route URI provided by the RDF (for initial requests), 2) the URI obtained from the Policy Routing Function (if applicable for transferred requests), 3) or the URI received in the Route header of the incoming INVITE message (for transferred requests where the Policy Routing Function does not determine a new Route URI value). The E-CSCF will populate this information in the Route header of the outgoing INVITE message that it generates to forward the emergency call request toward the PSAP.

Example:

The following example illustrates the Contact header for an emergency call request being routed to a NENA NG9-1-1 PSAP. (BCF headers are not accounted for.)

```
Contact:<sip:psap.st.county.net;lr>
```

The following example illustrates the Contact header for an emergency call request being routed to a legacy PSAP via the LPG. (BCF headers are not accounted for.)

Contact:<sip:psap.st.county.LPG.provider.example.net;lr>

The following example illustrates the Contact header for an emergency call request being routed to an ESRP in an interconnected i3 ESInet. (BCF headers are not accounted for.)

Contact:<sip:esrp.esinet.net;lr>

9.2.5 Procedures at Policy Routing Function (PRF)

The PRF is a functional component of the LRF. As such, this standard only defines the functionality associated with a PRF and does not specify the interfaces or define new reference points for the PRF.

The PRF determines whether an alternate PSAP should be chosen based upon pre-defined policy routing rules. For example, policy routing rules may be associated with night closure of a PSAP, scheduled maintenance, or other events/conditions that may prevent the PSAP from receiving emergency call requests. The policy routing rules governing these conditions/events, and the identification of the alternate PSAP, are specified by the PSAP or the 9-1-1 Authority. How the policy routing rules are provisioned into the PRF is beyond the scope of this Standard.

After the LRF receives routing instructions (i.e., a Route URI) from the RDF associated with an initial emergency call, or a URI in a Route header of an incoming INVITE message associated with a transferred emergency call, it interrogates the PRF with this Route URI to determine if there are policy routing rules that should modify the routing instructions that will be returned to the E-CSCF by the LRF. The PRF interrogates its internal policy store with this URI. If dictated by policy, the PRF will obtain an alternate URI. This URI will be returned to the LRF, and the LRF will populate this URI in the Contact header of the 300 Multiple Choices message that it returns to the E-CSCF.

9.3 Procedures at the RDF

The RDF will receive a location and service URN from the LRF and return a Route URI that may be used to route the call to a legacy PSAP (via an LPG), a NENA NG9-1-1 PSAP, an interconnected i3 ESInet, an interconnected IMS-based NG9-1-1 Emergency Services Network, or a legacy Emergency Services Network (via a Legacy Selective Router Gateway). In all cases, the RDF shall return a sip URI without “user=phone”.

If the RDF is unable to determine a Route URI based on the location provided in the routing request from the LRF, it should return a default Route URI to the LRF.

9.4 Procedures at the LNG

The LNG shall support the interworking procedures described in Clause 9.4 of ATIS-0500032. In addition, the LNG shall be capable of processing and responding to location dereference requests from NG9-1-1 PSAPs, LPGs, LSRGs, i3 ESRPs, and LRFs. The LNG shall also be capable of processing and responding to Additional Data dereference requests from NG9-1-1 PSAPs, LPGs, and LSRGs.

9.5 Procedures at the LPG

To support emergency call delivery to legacy PSAPs, the LPG applies signaling and service-specific interworking functionality to emergency originations to allow the information provided in incoming SIP signaling to be delivered to the legacy PSAP in a form that it can process. As described in Clause 9.5 of ATIS-0500032, the LPG is responsible for delivering initial and transferred emergency calls to legacy PSAPs via Traditional MF and E-MF interfaces. Callback and location information delivered to legacy PSAPs by an LPG will be in the form of a 7/10-digit North American Numbering Plan (NANP) number, and the LPG will perform the necessary mappings if the callback and/or location information received in incoming SIP signaling is not in the form of (or easily converted to) a 10-digit NANP number.

The LPG must be capable of receiving and processing requests for initial and updated (dispatch) location, using existing NENA-defined ALI query protocols. If the location information received by the LPG in incoming SIP signaling is a LbyR, the LPG will have to send a dereference request to obtain the location information for the call before returning the location information in the appropriate format in the ALI response message.

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The LPG must also be capable of using Additional Data structures to populate other fields in the ALI response. As described in Clause 9.5 of ATIS-0500032, if Additional Data has been delivered to the LPG “by-reference,” the LPG will need to support the HTTP GET method described in IETF RFC 2616 [Ref 24] to obtain the Additional Data “by-value.”

The LPG must be capable of interpreting requests for emergency call transfer received via Dual Tone Multi-Frequency (DTMF) signaling, following the procedures described in Clause 9.5 of ATIS-0500032.

The LPG must also be capable of processing transferred calls that are destined for legacy PSAPs that it serves. Incoming signaling associated with transferred calls from other PSAPs that are served by the same IMS-based NG9-1-1 Emergency Services Network or by a different emergency services network will include a pointer/reference to an EIDD. The EIDD contains “Additional Data” that the primary PSAP has collected about the call, caller, and location, either based on incoming signaling or by direct interaction with the caller and is expected to include callback information and location information. The LPG will send a dereference request to the primary NG9-1-1 PSAP, serving LPG, or Legacy Selective Router Gateway that generated the EIDD to obtain the data “by value”. The LPG will use the same mechanisms defined for emergency originations to ensure that the callback and/or location information delivered to the legacy PSAP with the transferred call is in a format that the PSAP can process.

In addition, the LPG will receive and must be able to process and respond to ALI requests from legacy PSAPs associated with emergency calls that have been transferred to them. The LPG will use the information provided in the EIDD to populate the ALI response. If the location information (or other information) in the EIDD is provided “by-reference”, the LPG will first send a dereference request to obtain the information “by-value”.

See Clause 7.2 of NENA-STA-010.2 [Ref 23] for further details related to LPG procedures and protocols.

9.6 Procedures at the IBCF

The IBCF shall adhere to Clauses 4 and 5.10 in 3GPP TS 24.229 [Ref 2] with additions as noted below. In the IMS-based NG9-1-1 Service Architecture, the IBCF will be both the entry point to the network and the exit point from the network. The role performed by the IBCF (i.e., a proxy or B2BUA) will vary based on local policy. When acting as a B2BUA, the IBCF will follow the taxonomy of B2BUA roles described in RFC 7092 [Ref 26].

9.6.1 Entry Point IBCF

The entry point IBCF will perform normal border control functions and once the message is validated it will forward the SIP INVITE to the I-CSCF. The entry point IBCF will ensure that the Resource Priority Header is set to esnet.1 to indicate an emergency call.

In support of the intra-network transfer procedures described in Clause 8.8.1.1 in ATIS-0500032, the entry point IBCF will act as a signaling/media plane B2BUA that supports replacement of the Contact header and anchors media when the Supported header in the incoming INVITE message does not include the Replaces option tag.

In support of internetwork transfer procedures, the entry point IBCF in a downstream IMS-based NG9-1-1 Emergency Services Network shall use the content of the Route header to route the call forward toward the NENA NG9-1-1 PSAP or the LPG.

The IBCF shall pass all headers, including P headers, and message bodies.

9.6.2 Exit Point IBCF

The exit point IBCF shall use the Route header to identify the target NENA NG9-1-1 PSAP or the LPG for initial emergency requests. The IBCF shall pass all headers (including P headers) and message bodies, unless passing of the parameters is prohibited with its role as a border gateway function. (See Clause 9.5 for further details related to the LPG.)

In support of the intra-network transfer procedures described in Clause 8.8.1.1 of ATIS-0500032, the exit point IBCF will act either as a proxy or as a B2BUA that does not modify the received To, From, or Contact header fields and does not terminate/anchor media (e.g., a Proxy-B2BUA).

In support of the intra-network transfer procedures described in Clause 8.8.1.2 of ATIS-0500032, the exit point IBCF will act as a signaling/media plane B2BUA that supports replacement of the Contact header and anchors media.

In support of internetwork transfer procedures, the exit IBCF in an upstream IMS-based NG9-1-1 Emergency Services Network will use the content of the Route header to determine the transfer-to emergency services network to which to deliver the call. The exit IBCF in a downstream IMS-based NG9 1 1 Emergency Services Network will use the Route header to route the transferred call toward the destination NENA NG9-1-1 PSAP or LPG.

9.7 Procedures at the I-CSCF

The I-CSCF shall adhere to Clauses 4 and 5.3 in 3GPP TS 24.229 [Ref 2] with additions and clarifications as noted in this clause.

The I-CSCF receives emergency requests from the IBCF. The I-CSCF identifies that the incoming call is an initial emergency call if either of the following conditions is true.

- SIP INVITE contains a URI with “911” as the user part in the “To” header-field.
- SIP INVITE contains urn:service:sos in the Request URI.

For incoming emergency calls that have been transferred by PSAPs served by other emergency services networks, the I-CSCF identifies that the incoming call is a transferred emergency call based on receipt of a Resource Priority Header set to “esnet.1” and/or the presence of an EIDD (i.e., the SIP INVITE includes a Call-Info header field with a purpose parameter of “eidd”).

Having identified the incoming call as an emergency call, the I-CSCF determines the address of the E-CSCF based on provisioned data.

The I-CSCF will route the emergency call to the E-CSCF based on the locally pre-configured E-CSCF address. The I-CSCF places the provisioned E-CSCF address in the topmost Route header-field of the outgoing SIP INVITE.

9.8 Procedures at the Conferencing Application Server (AS)

The procedures at the conferencing Application Server (AS) shall be the same as described in Clause 9.8 of ATIS-0500032.

9.9 Procedures at the Multimedia Resource Function Controller (MRFC)

In support of emergency call transfer in North America the MRFC shall support the procedures defined in Clause 5.2.2 of 3GPP TS 24.147 [Ref 9].

9.10 Procedures at the Multimedia Resource Function Processor (MRFP)

In support of emergency call transfer in North America, the MRFP shall provide the mixing of incoming media streams associated with multiple parties following the procedures specified in IETF RFC 4353 [Ref 10].

9.11 Procedures at the Transit Function (TRF)

The conferencing TRF shall adhere to the procedures described in Clause 5.19.1 of 3GPP TS 23.228 [Ref 15] with the clarifications as noted in this clause.

When a PSAP initiates the transfer of an emergency call toward a transfer-to PSAP, the conferencing AS may, as an operator option, communicate with a TRF to support routing of the session initiation request if the AS does not support the necessary routing capabilities. The TRF will be responsible for performing an analysis of the destination address and determining where to route the session. The TRF is expected to route a session initiation request that is destined for a transfer-to PSAP via an IBCF.

9.12 Procedures at the Legacy Selective Router Gateway (LSRG)

Legacy Selective Router Gateways (LSRGs) support emergency call delivery to legacy PSAPs that are served by legacy Selective Routers, as well as transfers to/from PSAPs that are served by Selective Routers. Like the LNG and LPG, the LSRG applies signaling and service-specific interworking functionality to emergency originations and transferred emergency calls.

To support the delivery of emergency calls from an IMS-based NG9-1-1 Emergency Services Network to a PSAP that is served by a legacy SR, the LSRG will be responsible for interworking incoming SIP signaling to SS7 signaling for delivery to a legacy Selective Router. The LSRG will select the outgoing route to the Selective Router based on the destination PSAP number/address provided in the Route URI of the incoming INVITE message. The SS7 signaling sent by the LSRG to the Selective Router is expected to include the following information: PSAP number/address received in the Request URI of the incoming INVITE message populated in the SS7 Called Party Number parameter; the pANI or callback number provided in the P-Asserted-Identity header of the received INVITE message (or generated by the LSRG, as described below) populated in the SS7 Calling Party Number parameter; a Calling Party's Category set to "emergency service call"; and a Nature of Connections indicator, Forward Call Indicators, User Service Information parameter, and optionally, a Higher Layer Compatibility information element within the Access Transport Parameter, as described in Clause 6.1.3 of ATIS-1000679. 2015. The SS7 signaling may also include a Generic Digits Parameter that contains a pANI generated by the LSRG, if appropriate based on the interface to the legacy Selective Router. The legacy Selective Router 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 Clause 5.1.2 of NENA 03-003.

SS7 interfaces to legacy Selective Routers assume that callback information and/or location keys (i.e., pANIs) signaled to the legacy Selective Router will be in the form of a 10-digit NANP number. Some emergency originations 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 LSRG will 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.

Location information associated with an initial emergency call that is delivered to an LSRG using SIP is expected to be in the form of a civic address or geodetic coordinates (if delivered "by-value") or a reference URI (if delivered "by-reference"), rather than a NANP number. The LSRG will be expected to map this information to a location key (i.e., pANI) that is in the form of an ESN-appropriate 10-digit pANI so that it can be delivered to the legacy Selective Router.

The LSRG will also be capable of receiving and processing requests for initial and updated (dispatch) location from legacy ALI systems, using the E2 protocol or Mobile Location Protocol (MLP). If the location information received by the LSRG in incoming SIP signaling is a LbyR, the LSRG will have to initiate a dereference request to obtain the location information for the call before returning the location information in the appropriate format in the E2/MLP response message.

To populate additional information beyond just the callback number and location information in an E2/MLP response, the LSRG will use Additional Data structures received in incoming SIP signaling "by reference" or "by value". If Additional Data has been delivered to the LSRG "by-reference," the LSRG will need to support the HTTP GET method described in IETF RFC 2616 [Ref 24] to obtain the Additional Data "by-value." The LPG will use the information contained in the Call-Info header of the received INVITE to either identify the address of the target Additional Data Repository (ADR) to which the GET will be directed, or to identify the place in the message body where the Additional Data is provided "by-value".

Calls that are transferred by PSAPs that are served by an IMS-based NG9-1-1 Emergency Services Network to legacy PSAPs that are served by Selective Routers will also traverse an LSRG. The incoming SIP signaling associated with these transferred calls will be the same as the signaling associated with calls that are transferred to PSAPs that are served by downstream i3 ESNets or IMS-based NG9-1-1 Emergency Services Networks. Specifically, the SIP INVITE associated with these transferred calls will include a Contact header that contains the conference URI and isfocus parameter, a Route header that contains the address of the transfer-to PSAP, as well as a Call-Info header field containing a reference URI that points to the EIDD data structure and a purpose parameter of "eidd". The LSRG will send a dereference request to the entity identified in the reference URI to obtain the EIDD data "by value". The LSRG will use the same mechanisms as are used for emergency originations to ensure that the callback and/or location information delivered via SS7 to the Selective Router with the transferred

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call is in a format that can be processed by downstream legacy elements. Note that for incoming transferred calls, the LSRG will use the content of the EIDD to populate responses to E2/MLP queries from ALI systems.

LSRGs will also play a role in delivering initial or transferred emergency calls to downstream IMS-based NG9-1-1 Emergency Services Networks. An initial emergency call routed from an LSRG to a downstream IMS-based NG9-1-1 Emergency Services Network will contain essentially the same information as an initial emergency call routed from an upstream IMS-based NG9-1-1 Emergency Services Network, except that it will identify the LSRG in the Contact and Via headers. The information generated by an LSRG in outgoing SIP signaling associated with an emergency call that is transferred by a legacy PSAP that is served by a Selective Router to a PSAP that is served by downstream IMS-based NG9-1-1 Emergency Services Network will differ from the signaling associated with a transferred call from an upstream IMS-based NG9-1-1 Emergency Services Network in the following ways: the LSRG will populate a service URN associated with Selective Transfer (e.g., urn:nena:service:sos.police) in the Request-URI, and the Via and Contact headers will identify the LSRG. Note that the LSRG will be responsible for creating the EIDD, populating whatever information it has available to it in the data structure (i.e., location information [by-value or by-reference], callback information, as well as any Additional Data structures received with the call).

Annex A (normative) – SIP INVITE Profile for Emergency Calls

This normative annex provides the SIP INVITE profile for emergency calls sent from an IMS-based NG9-1-1 Service Network Upstream IBCF and sent to an IBCF in any Downstream NG9-1-1 Emergency Services Network. Headers not included in this table are not pertinent to emergency calls and may be ignored.

Table A-1: SIP INVITE Header Profile Legend

Code	Code Name	Sending Side	Receiving Side
M	Mandatory	The capability shall be supported. It is a static view of the fact that the conformance requirements related to the capability in the reference specification are mandatory requirements. This does not mean that a given behavior shall always be observed, but that it shall be observed when the implementation is placed in conditions where the conformance requirements from this document compel it to do so. For instance, if the support for a header in a sent request or response is mandatory, it does not mean that it shall always be present, but that it shall be present according to the description of the behavior in this document.	Same as in the sending side with the following additions: Processing should not continue if required information is unavailable. (Suitable disconnection/release processing should be performed.) However, when a default value has been decided upon, processing is performed using the default value.
O	Optional	The capability may or may not be supported. It is an implementation choice.	Same as in the sending side with the following additions: If possible, perform the processing expected by the sending side. When the processing expected by the sending side cannot be performed, the received content should be ignored and processing should continue.
-	Not Supported	The capability is not supported or beyond the scope of this standard.	The capability is not supported or beyond the scope of this standard.
S	Recommended	The capability should be supported. It is an implementation choice.	Same as in the sending side with the following additions: If possible, perform the processing expected by the sending side. When the processing expected by the sending side cannot be performed, the received content should be ignored and processing should continue.

The following identifies the use of the columns:

- **Header** – Header name.
- **IMS-based NG9-1-1 Services Network Upstream IBCF** – Headers sent to Downstream ESN via the egress IBCF.
- **Downstream IBCF** – Headers Received at the ingress IBCF of the Downstream ESN.
- **Reference and Notes** – Reference RFCs and clarifying notes.
- **Initial and Bridge** – Indicates applicability for initial call [e.g., I(O)] and bridged call [e.g., B(O)]. If I and B not specified, applies to both.

Table A-2: SIP INVITE Header Profile

Header	IMS-based NG9-1-1 Services Network Upstream IBCF	Downstream IBCF	Reference and Notes
Accept	O	O	RFC 3261 [Ref 14] Clause 20.1.
Accept-Encoding	O	O	RFC 3261 Clause 20. 2.
Accept-Language	O	O	RFC 3261 Clause 20.3. The "Accept-Language" header MAY be present in requests with a value of "en" for English, which should be supported. Other values MAY be supported.
Allow	S	S	RFC 3261 Clause 20.5. The header value should list all supported methods, i.e., at a minimum, "INVITE", "ACK", "CANCEL", "BYE", "OPTIONS", and "PRACK".
Call-ID	M	M	RFC 3261 Clause 20.8.
Call-Info	M	M	RFC 3261 Clause 20.9 and Clause 9 of this standard. For an initial call the Call-Info will provide NENA Call ID, Incident ID and Additional Data. For Bridged calls, it will contain reference (e.g., URI) to the EIDD.
Contact	M	M	RFC 3261 Clause 20.9. For bridged calls this will contain the ISFOCUS of the Upstream Conference AS.
Content-Language	O	O	RFC 3261 Clause 20.13.
Content-Length	M	M	RFC 3261 Clause 20.14.
Content-Type	M	M	RFC 3261 Clause 20.15, RFC 6442 [Ref 12] Clause 5.1. The value of "multipart/mixed" MUST be supported. The value of "application/sdp" MUST be supported. The value of "application/pdf+xml" MAY be supported and MUST be supported if LbyV is included in the body of the SIP INVITE message.
Cseq	M	M	RFC 3261 Clause 20.16.
From	M	M	RFC 3261 Clause 20.20.
Geolocation	I(M) B(-)	I(M) B(-)	RFC 6442 Clause 4.1 and Clause 9 of this standard.
Geolocation-Routing	I(M) B(-)	I(M) B(-)	RFC 6442 Clause 4.2 and Clause 9 of this standard.
History-Info	I(O) B(M)	I(O) B(M)	RFC 7044 [Ref 19]. Elements in an NG9-1-1 Emergency Services Network that retarget a call MUST add a History-Info header to the SIP INVITE message indicating the original intended recipient, and the reason why the call was retargeted. For an initial call, the Upstream IBCF and Downstream IBCF must be capable of passing a History-Info header if received. A History-Info header will be present in an INVITE associated with an initial emergency call if the call was retargeted (e.g., due to a Policy Routing Rule). The History-Info header SHALL be present in SIP INVITE messages associated with transferred emergency calls

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Header	IMS-based NG9-1-1 Services Network Upstream IBCF	Downstream IBCF	Reference and Notes
Max-Forwards	M	M	RFC 3261 Clause 20.22. When the IBCF implementation of a back-to-back User Agent (B2BUA) forwards a request, it MUST use a Max-Forwards value equal to the incoming Max-Forwards value minus one.
MIME-Version	O	O	RFC 3261 Clause 20.24. The version "1.0" value is the default; other values MAY be supported.
P-Access-Network-Info Header	I(O) B(-)	I(O) B(-)	RFC 3455 [Ref 20] Clause 4.4.1.
P-Asserted-Identity	I(O) B(-)	I(O) B(-)	RFC 3325 [Ref 21] Clause 4 and Clause 9 of this standard.
P-Charging-Vector Header	I(O) B(-)	I(O) B(-)	RFC 3325 Clause 4.6. If the P-Charging-Vector header is included in the incoming SIP INVITE it is expected that it identifies the originating carrier.
Record-Route	M	O	RFC 3261 Clause 20.30.
Reply-To	-	-	RFC 3261 Clause 20.31.
Require	O	O	RFC 3261 Clause 20.32. The option tags "precondition", "replaces", and "100rel" MUST be supported.
Resource-Priority	M	O	RFC 4412 [Ref 16], updated by RFC 7134 [Ref 17].
Route	M	M	RFC 3261 Clause 20.34 and Clause 9 of this standard.
Supported	M	M	RFC 3261 Clause 20.37. The values "precondition", "replaces" and "100rel" may be supported. However, a value present in the "Require" header SHOULD NOT also be present in the Supported header.
To	M	M	RFC 3261 Clause 20.39.
Unsupported	O	O	RFC 3261 Clause 20.40.
Via	M	M	RFC 3261 Clause 20.42.

Annex B (informative) – Message Examples

This informative Annex provides message examples for various use cases.

B.1 Initial Call from Upstream to Downstream Emergency Services Network Example

This example illustrates the scenario where the Upstream IMS-based NG9-1-1 Emergency Services Network has determined that the initial call must be routed to the Downstream i3 Emergency Services Network.

```

INVITE urn:service:sos SIP/2.0
Via: SIP/2.0/UDP BCF.Upstream-ESN.net;branch=z9hG4bK77993dd
Route: <sip:esrp.DownStream-ESN.net>;lr
From: <sip:+13125551234@osp.provider.example.net;user=phone>;tag=23ac
To: sip:911@esnet.example.net
Contact: <sip:+13125551234@osp.provider.example.net>;user=phone
P-Asserted-Identity: <sip:+13125551234@osp.provider.example.net>;user=phone
Geolocation: <cid:target-loc@osp.provider.example>
Geolocation-Routing:yes
Call-Info: <urn:ena:uid:callid:a56e556d871:bcf.Upstream-ESN.net>;purpose= nena-CallId
Call-Info: <urn:ena:uid:incidentid:b34e556d225:bcf.Upstream-ESN.net>;purpose= nena-
IncidentId
Call-Info: <cid:ProviderInfo@osp.provider.example>;
purpose=EmergencyCallData.ProviderInfo
Call-Info: <cid:ServiceInfo@osp.provider.example>;
purpose=EmergencyCallData.ServiceInfo
Resource-Priority:esnet.1
Max-Forwards: 68
Call-ID: 19dn30
CSeq: 1 INVITE
Supported: 100rel, geolocation
Accept: application/sdp, application/pidf+xml, application/xml
Content-Type: multipart/mixed;boundary=boundary1
Content-Length: nn
--boundary1
Content-Type:application/sdp
[SDP here]
--boundary1
Content-Type: application/pidf+xml
Content-ID: target-loc@osp.provider.example
[PIDF-LO here]
--boundary1
Content-Type: application/xml
Content-ID: ProviderInfo@osp.provider.example
[Provider Information here]
--boundary1
Content-Type: application/xml
Content-ID: ServiceInfo@osp.provider.example
[Service Information here]
--boundary1--

```

B.2 Bridged Call from Upstream to Downstream Emergency Services Network Example

This example illustrates the scenario where the PSAP in the Upstream IMS-based NG9-1-1 Emergency Services Network has determined that it needs to transfer a call to a PSAP in the Downstream i3 Emergency Services Network.

```

INVITE urn:service:sos SIP/2.0

```

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Via: SIP/2.0/UDP BCF.Upstream-ESN.net;branch=z9hG4bK77993dd
Route: <sip:esrpDownStream-PSAP.DownStream-ESN.net>;lr
From: <sip:Conf-AS@Upstream-ESN.net>;tag=23ac
To: <sip:DownStream-PSAP.DownStream-ESN.netsip:Sec-PSAP@Downstean-ESN.net>
Contact: <sip:Conf-AS@Upstream-ESN.net>;isfocus
Call-Info: <http:NG911PSAP_A.911Authority_A.net/eidd09245673>;purpose=eidd
Allow: INVITE, ACK, BYE, CANCEL, OPTIONS, PRACK, INFO, REFER, SUBSCRIBE, NOTIFY
History-Info: <sip:NG911PSAP-A@911Authority-A.net;index=1;mp=1
<sip:NG911PSAP-A@911Authority-A.net?Reason="Bridge Request";cause=200;text="Bridge
Request">;index=1.1;mp=1.1
Resource-Priority:esnet.1
Max-Forwards: 68
Call-ID: 19dn30
CSeq: 1 INVITE
Supported: 100rel
Content-Length: nn
[SDP here]