ATIS STANDARD

ATIS-0500032

ATIS Standard on -

ATIS STANDARD FOR IMPLEMENTATION OF AN IMS-BASED NG9-1-1 SERVICE ARCHITECTURE

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ATIS Standard on

ATIS Standard for Implementation of an IMS-based NG9-1-1 Service Architecture

Alliance for Telecommunications Industry Solutions

Approved November 21, 2016

Abstract

This Standard defines the Stage 2 (architecture) and Stage 3 (protocol) specifications for an IMS-based NG9-1-1 Service Architecture. This Standard 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".

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 this joint work effort that addresses the application of common IMS (Stage 1, 2, and 3) for the processing, transport, and/or delivery of Emergency Service calls within the NG9-1-1 network to the appropriate PSAP. 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 forums/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 organizations, 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 system 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.

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

T. Reese, ESIF Chair, ESIF IMS911 Co-Chair, ESIF NGES Co-Chair (Ericsson)

J. English, ESIF First Vice-Chair (APCO International)

S. Sherwood, ESIF Second Vice-Chair (Verizon Wireless)

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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 design[1]. Additionally, the NENA i3 Architecture Working Group[2] deferred the IMS-based 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 still 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 (911SSP) 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

This ATIS Standard applies IP Multimedia Subsystem (IMS) architecture concepts to Next Generation 9-1-1 (NG9-1-1) networks to encompass:

- Definition of an IMS-based NG9-1-1 Emergency Services Network architecture and set of additional gateway functional elements that are integrated into this IMS-based NG9-1-1 Service Architecture, adopted from the existing NENA i3 architecture, to support the delivery of emergency calls to legacy and NG9-1-1/i3 PSAPs.
- NG9-1-1 network deployment scenarios showing an IMS-based NG9-1-1 Service Architecture interconnecting with a variety of originating network and PSAP types, and associated Stage 2/3 call flows.

[1] IMS is a set of standards based on the IETF RFC 3261 [Ref 18] 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 27].

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 defined call processing, transport, or delivery of Emergency Service calls by an IMS-based NG9-1-1 Emergency Services Network.

The purpose of this Standard is to define the Stage 2 (architecture) and Stage 3 (protocols) to enable North American deployment of NG9-1-1 emergency services networks that are based upon the 3GPP IMS specifications. This IMS-based NG9-1-1 emergency services network is called IMS-based NG9-1-1 Service Architecture.

This Standard 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" [Ref 26].

1.3 Application

The standard applies to requests for emergency services originating from legacy, IMS-based, and generic VoIP originating networks by routing those emergency service requests to the appropriate PSAP. 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*, August 2008.[4]

[Ref 7] J-STD-036-C, *Enhanced Wireless 9-1-1 Phase II*, June 2011 including the addendum in J-STD-036-C-1, *Addendum to J-STD-036-C, Enhanced Wireless 9-1-1 Phase II*, October 2013.[5]

[Ref 8] IETF RFC 5139, *Revised Civic Location Format for Presence Information Data Format Location Object (PIDF-LO),* February 2008.[4]

[Ref 9] IETF RFC 6753, *A Location Dereferencing Protocol Using HELD*, October 2012.[4]

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

[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/product.aspx?id=26080 >.

[Ref 10] IETF RFC 5491, *GEOPRIV Presence Information Data Format Location Object (PIDF-LO) Usage Clarification, Considerations, and Recommendations*, March 2009.[4]

[Ref 11] 3GPP TS 24.147, *Technical Specification Group Core Network and Terminals; Conferencing using the IP Multimedia (IM) Core Network (CN) subsystem; Stage 3*.[3]

[Ref 12] IETF RFC 7852, *Additional Data related to an Emergency Call*, July 2016.[4]

[Ref 13] IETF 4353, *A Framework for Conferencing with the Session Initiation Protocol (SIP)*, February 2006.[4]

[Ref 14] ATIS-1000679.2015, *Interworking between Session Initiation Protocol (SIP) and Bearer Independent Call Control or ISDN User Part*.[6]

[Ref 15] IETF RFC 6442, *Location Conveyance for the Session Initiation Protocol*.[4]

[Ref 16] IETF RFC 4119, *A Presence-based GEOPRIV Location Object Format*.[4]

[Ref 17] IETF RFC 3265, *Session Initiation Protocol (SIP) – Specific Event Notification*.[4]

[Ref 18] IETF RFC 3261, *SIP: Session Initiation Protocol*.[4]

[Ref 19] 3GPP TS 23.228, *Technical Specification Group Services and System Aspects; IP Multimedia Subsystem (IMS)*; Stage 2.[3]

[Ref 20] IETF RFC 4112, *Communications Resource Priority for the Session Initiation Protocol (SIP)*, February 2006.[4]

[Ref 21] IETF RFC 7134, *The Management Policy of the Resource Priority Header (RPH) Registry* Changed to "IETF Review", March 2014.[4]

[Ref 22] IETF RFC 4579, *Session Initiation Protocol (SIP) Call Control - Conferencing for User Agents*, August 2006.[4]

[Ref 23] IETF RFC 7044, *An Extension to the Session Initiation Protocol (SIP) for Request History Information*, February 2014.[4]

[Ref 24] IETF RFC 3455, *Private Header (P-Header) Extensions to the Session Initiation Protocol (SIP) for the 3rd-Generation Partnership Project (3GPP)*, January 2003.[4]

[Ref 25] IETF RFC 3325, *Private Extensions to the Session Initiation Protocol (SIP) for Asserted Identity within Trusted Networks*, November 2002.[4]

[Ref 26] ATIS-0500023, *Applying Common IMS to NG9-1-1 Networks*, April, 2013.[6]

[Ref 27] NENA-STA-010.2, *Detailed Functional and Interface Standards for the NENA i3 Solution*, September 10, 2016.[7]

[Ref 28] IETF RFC 2616, *Hypertext Transfer Protocol -- HTTP/1.1*, June 1999.[4]

[Ref 29] IETF RFC 4103, *RTP Payload for Text Conversation*, June 2005.[4]

[Ref 30] IETF RFC 4975, *The Message Session Relay Protocol (MSRP)*, September 2007.[4]

[Ref 31] IETF RFC 4575, *A Session Initiation Protocol (SIP) Event Package for Conference State*, August 2006.[4]

[Ref 32] 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 33] IETF RFC 7092, *A Taxonomy of Session Initiation Protocol (SIP) Back-to-Back User Agents*, December 2013.[4]

[Ref 34] IETF RFC 7647, *Clarifications for the Use of REFER with RFC 6665*, September 2015.[4]

[6] This document is available from the ATIS, 1200 G Street N.W., Suite 500, Washington, DC 20005 at: < https://www.atis.org/docstore/product.aspx?id=25371 >.

[7] This document is available from the National Emergency Number Association. <NENA Standards & Other Documents>

[Ref 35] IETF RFC 3891, *The Session Initiation Protocol (SIP) "Replaces" Header*, September 2004.[4]

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, *NENA Master Glossary of 9-1-1 Terminology*.[8]

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)[9]	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.[9]
Emergency Services IP network (ESInet)[10]	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 NG911 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)[10]	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.

[8] Available from the National Emergency Number Administration (NENA) at: < NENA Master Glossary >.

[9] Refer to NENA-ADM-000.18-2014, NENA Master Glossary of 9-1-1 Terminology [Ref 101].

[10] Refer to NENA i3/NG9-1-1 [Ref 27].

Legacy PSAP Gateway (LPG)[10]	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[11]	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.[8]
Non Call Associated Signaling (NCAS)	NCAS is a signaling method for legacy wireless calls where the calling (E.164) number and the Reference Identifier are sent. The Reference Identifier is used for routing calls. Both the calling number and the Reference Identifier may be used for retrieving location and additional data. (a) If the call is delivered over an SS7 trunk group, the call setup signaling includes the calling number sent in the Calling Party Number parameter, the Reference Identifier is sent in the SS7 GDP, and the digits "911" in the SS7 Called Party Number parameter. (b) If the call is delivered over an MF trunk group, the call setup signaling includes the Reference Identifier signaled as the called number, and the calling number signaled as the ANI.
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.[12]

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

[12] 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.

Wireline Compatibility Mode (WCM)	WCM is a signaling method for legacy wireless calls where only the Reference Identifier is sent and used for routing, and for retrieving location and additional data. The originating MSC sends an emergency call origination from a legacy wireless caller to the Legacy Network Gateway over an MF or SS7-supported trunk group. The call setup signaling includes the Reference Identifier (as the calling number) and the digits “911” (as the called number).

4.2 Acronyms & Abbreviations

3GPP	Third Generation Partner Program
ACM	SS7 Address Complete Message
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
BGCF	Breakout Gateway Control Function
CAMA	Centralized Automatic Message Accounting
cid	Content-ID
CdPN	Called Party Number
CPN	Calling Party Number
DTMF	Dual Tone Multi-Frequency
CSeq	Command Sequence
E-CSCF	Emergency Call Session Control Function
ECRF	Emergency Call Routing Function (NENA i3)
EIDD	Emergency Incident Data Document
ESInet	Emergency Services IP network
ESQK	Emergency Services Query Key
ESRD	Emergency Services Routing Digits
ESRK	Emergency Services Routing Key
FG	Feature Group
GDP	Generic Digits Parameter
GMLC	Global Mobile Location Center
HELD	HTTP-Enabled Location Delivery
HTTP	Hypertext Transfer Protocol
HTTPS	HTTP Secure
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

KP	Key Pulse
LbyR	Location by Reference
LbyV	Location by Value
LIS	Location Information Server
LNG	Legacy Network Gateway
LPG	Legacy PSAP Gateway
LRF	Location Retrieval Function
LS	Location Server
MF	Multi Frequency
MGCF	Media Gateway Control Function
MGW	Media Gateway
MRFC	Media Resource Function Controller
MRFP	Media Resource Function Processor
MSC	Mobile Switching Center
NANP	North American Numbering Plan
NCAS	Non Call Associated Signaling
NENA	National Emergency Number Association
NPD	Numbering Plan Digit
OLI (oli)	Originating Line Information (parameter)
OSP	Originating Service Provider
PAI	P-Asserted-Identity
PIDF-LO	Presence Information Data Format – Location Object
PRF	Policy Routing Function
PSAP	Public Safety Answering Point
RLC	SS7 Release Complete
RDF	Routing Determination Function
REL	SS7 Release Message
RTT	Real Time Text
SDP	Session Description Protocol
SIP	Session Initiation Protocol
SS7	Signaling System Number 7
TDM	Time Division Multiplexing
TN	Telephone Number
TRF	Transit Function
UDP	User Datagram Protocol
URI	Uniform Resource Identifier
URN	Uniform Resource Name
VoIP	Voice over IP
WCM	Wireline Compatibility Mode

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. It addresses interconnection from originating legacy, IP-based IMS, and IP-based non-IMS networks. It also addresses emergency call delivery to both i3 and legacy PSAPs. This standard uses 3GPP IMS standards as its base and consideration must be given to how the specific aspects of the 3GPP IMS standards apply within the context of the North America emergency services architecture.

North American origination networks originate emergency calls (which include steps taken by originating device and network elements) and route such calls to a terminating IMS-based NG9-1-1 Emergency Services Network as defined in this standard.

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 are based on those defined in the Stage 1 document ATIS-0500023 [Ref 26] and are modified to reflect the evolution of the IMS-based NG9-1-1 Service Architecture.

1. Calls may ingress from legacy originating networks and require no changes to those networks.
2. Based upon routing criteria, calls ingressing from legacy originating networks or from Originating Service Provider (OSP) networks that use NENA i3 compliant interfaces will be delivered either to legacy PSAPs or NENA i3 compliant PSAPs.
3. Calls ingressing from OSP networks that use NENA i3 compliant interfaces may include Location-by-Value (LbyV) or Location-by-Reference (LbyR).
4. If calls are received with LbyR, the IMS-based NG9-1-1 Service Architecture network will have to de-reference the location reference to retrieve the LbyV in order to route the call.
5. The IMS-based NG9-1-1 Service Architecture network must support sending, receiving, and transfer of calls from/to NENA i3 compliant ESInets and from/to legacy emergency services networks. (Details related to the interconnection of the IMS-based NG9-1-1 Service Architecture with other legacy and Next Generation Emergency Services Networks are outside the scope of this Standard.) The IMS-based NG9-1-1 Service Architecture will route calls based upon location with or without policy considerations. Note that the location may be received (by value) with the call or the IMS-based NG9-1-1 Service Architecture may have to retrieve location.
6. Calls delivered to legacy PSAPs will include either the calling number/ANI or a pANI, and in some cases a callback number. The legacy PSAP will have to query the LPG to retrieve the location and, if not previously received, the callback number.
7. For calls from fixed or nomadic VoIP or IMS OSP networks, the IMS-based NG9-1-1 Service Architecture should deliver LbyV to the NENA i3 compliant PSAP.
8. For calls from mobile OSP networks, the IMS-based NG9-1-1 Service Architecture should deliver LbyR to the NENA i3 compliant PSAP. The NENA i3 PSAP must be able to de-reference the LbyR to retrieve a LbyV. The de-reference request may follow different paths depending on where the LbyR was generated.
    a. If the LbyR received by the i3 PSAP was generated by an LRF in an IMS-based originating network, the i3 PSAP will query the LRF in the originating network to retrieve the LbyV.
    b. If the LbyR received by the i3 PSAP was generated by a LIS/LS in a VoIP access network, the i3 PSAP will query the LIS/LS in the VoIP access network to retrieve the LbyV.
    c. If the originating network is a legacy wireless network, then gateway functionality within the LNG will be responsible for generating the LbyR that is delivered to the i3 PSAP. In this scenario, the i3 PSAP will query the LNG, and that element will be responsible for interacting with an MPC/GMLC in the legacy wireless originating network.

9. For the purposes of this document, VoIP fixed, nomadic, and mobile emergency services have all been addressed by Originating Service Providers.
10. The IMS-based NG9-1-1 Emergency Services Network described in this specification will replicate the functionality provided by a NENA i3 ESInet 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.
11. Direct interconnection of interim VoIP originating networks to IMS-based NG9-1-1 Emergency Services Networks is left to implementation. Support for emergency originations from interim VoIP networks that are routed via a legacy Selective Router (as described in NENA 08-001, Version 2) to an IMS-based NG9-1-1 Emergency Services Networks will be addressed as part of a future work item.

6.2 Requirements

Requirements used to develop this standard are defined in the Stage 1 document ATIS-0500023 [Ref 26].

7 Architecture

7.1 Overview

Figure 7-1 contains an illustration of the IMS origination network emergency call architecture from 3GPP TS 23.167 [Ref 1].

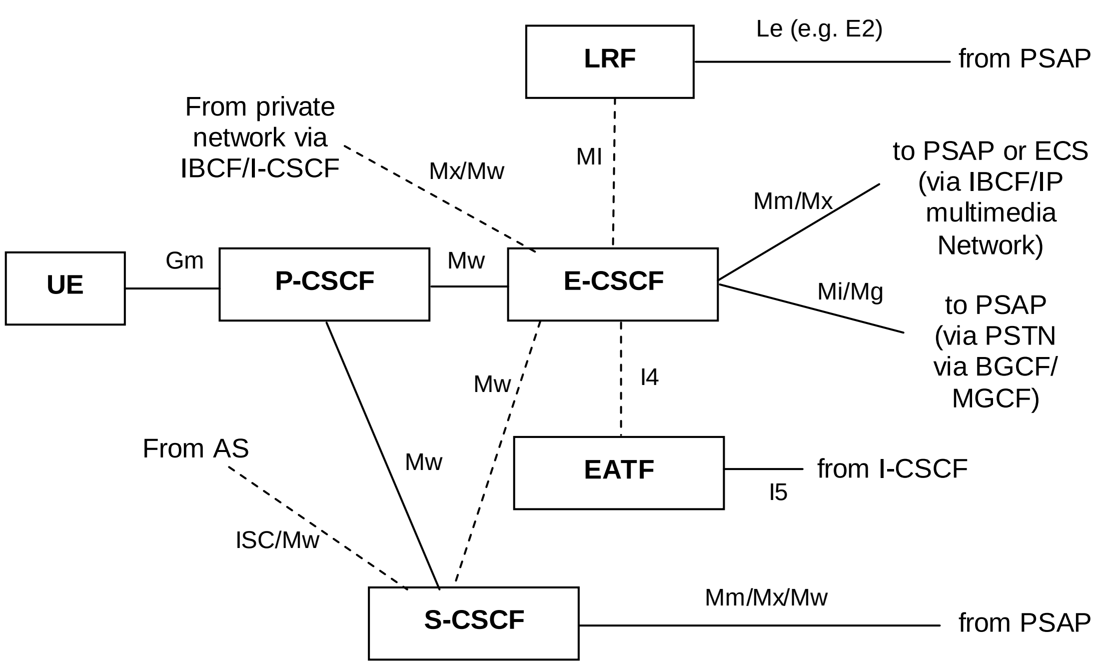

Figure 7-1: IMS origination network emergency call architecture from 3GPP TS 23.167

For a more complete architectural view, see 3GPP TS 23.002 [Ref 4].

Figure 7-2 illustrates an expanded architecture.

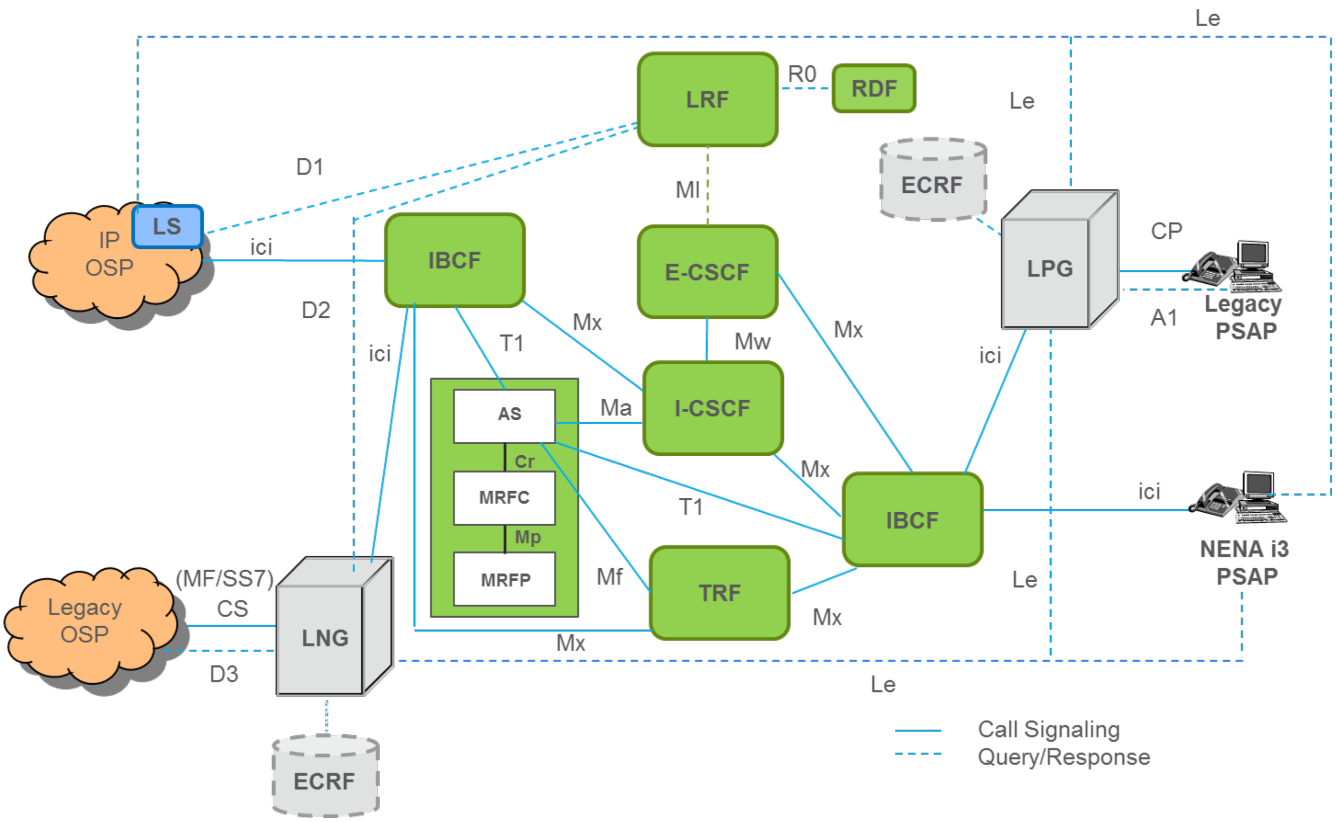

Figure 7-2: IMS-Based NG9-1-1 Service Architecture

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

This Section 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 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 19] and its applicability is extended in this standard. Emergency call requests are received from the 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 RDF. The LRF obtains routing information for an emergency session from the Routing Determination Function (RDF). It returns the routing information to the E-CSCF.

7.2.4 Routing Determination Function (RDF)

The Routing Determination Function (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. This routing information will designate a legacy PSAP or a NENA i3 PSAP.

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. If the IP Originating Service Provider network is a non-IMS i3-compliant originating network, the LS represents a 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 LS functionality is dependent upon the type of call in order to obtain location information and is out of scope of 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 19] 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 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 14]. 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 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 deference 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 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 Emergency Incident Data Document [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. See Clause 8.8.2.1.3 for further details on use of the ECRF. 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 11] 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 11] 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 Multimedia Resource Function Processor (MRFP) is used here as defined in 3GPP TS 23.002 [Ref 4] and 3GPP TS 24.147 [Ref 11] 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 19] 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 an MGCF, a BGCF, an 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 Secondary PSAP that is outside of the IMS-based Next Generation Emergency Services Network.

7.3 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 7-2 illustrates the architecture for location acquisition and routing for emergency services. The following functional elements and associated reference points are illustrated:

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

  The Ml interface is defined in 3GPP TS 23.167 [Ref 1] and expanded upon in Sections 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 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 of findService and findServiceResponse are used. It is assumed that the RDF returns a SIP URI in all cases, regardless of the destination (i.e., 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 9]. The messages of 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 9]. The messages of locationRequest and locationResponse are used. The use of SIP SUBSCRIBE/NOTIFY [Ref 17] 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 the 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 the 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 32].

- *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.

Note that the Le Reference Point associated with the LRF, as defined in 3GPP TS 23.167, is not applicable for the IMS-based NG9-1-1 Service Architecture. For call requests that contain a location reference, the NENA i3 PSAP will either query the LNG or the IP OSP network for location information. For call requests that contain a location reference, the legacy PSAP will query the LPG, which in turn will either query the LNG or the IP OSP network for location information.

8 Stage 2 Call Flows

8.1 Legacy Wireline Origination to i3 and Legacy PSAPs

8.1.1 Delivery of Legacy Wireline Emergency Call Origination to i3 PSAP

The call flow provided in Figure 8-1 illustrates a scenario where a legacy wireline emergency call is delivered by a legacy origination network via SS7 or MF trunks to an IMS-based NG9-1-1 Emergency Services Network. The call is delivered to an i3 LNG on the ingress side of the IMS-based NG9-1-1 Emergency Services Network with an E.164 number as the SS7 Calling Party Number/MF ANI and the digits “911” as the called number. This call flow assumes that the LNG will use the E.164 number to query a local location server/database that contains static TN-to-location mappings to obtain the routing/dispatch location for the call. This location information is then passed “by-value” to the IMS-based NG9-1-1 Emergency Services Network. The location is used by the LRF to query the RDF for call routing information. This call flow assumes that the Route URI that is returned by the RDF is the URI associated with an i3 PSAP. Furthermore, this call flow assumes that the call is delivered to the i3 PSAP with the LbyV that was provided to the IMS-based NG9-1-1 Emergency Services Network by the LNG, as well as Additional Data (by-value) that was provided by the LNG.

NOTE: The I-CSCF does not add itself to the Record-Route header in the call flows in Clause 8. The E-CSCF may or may not add itself to the Record-Route header (see section 9.1).

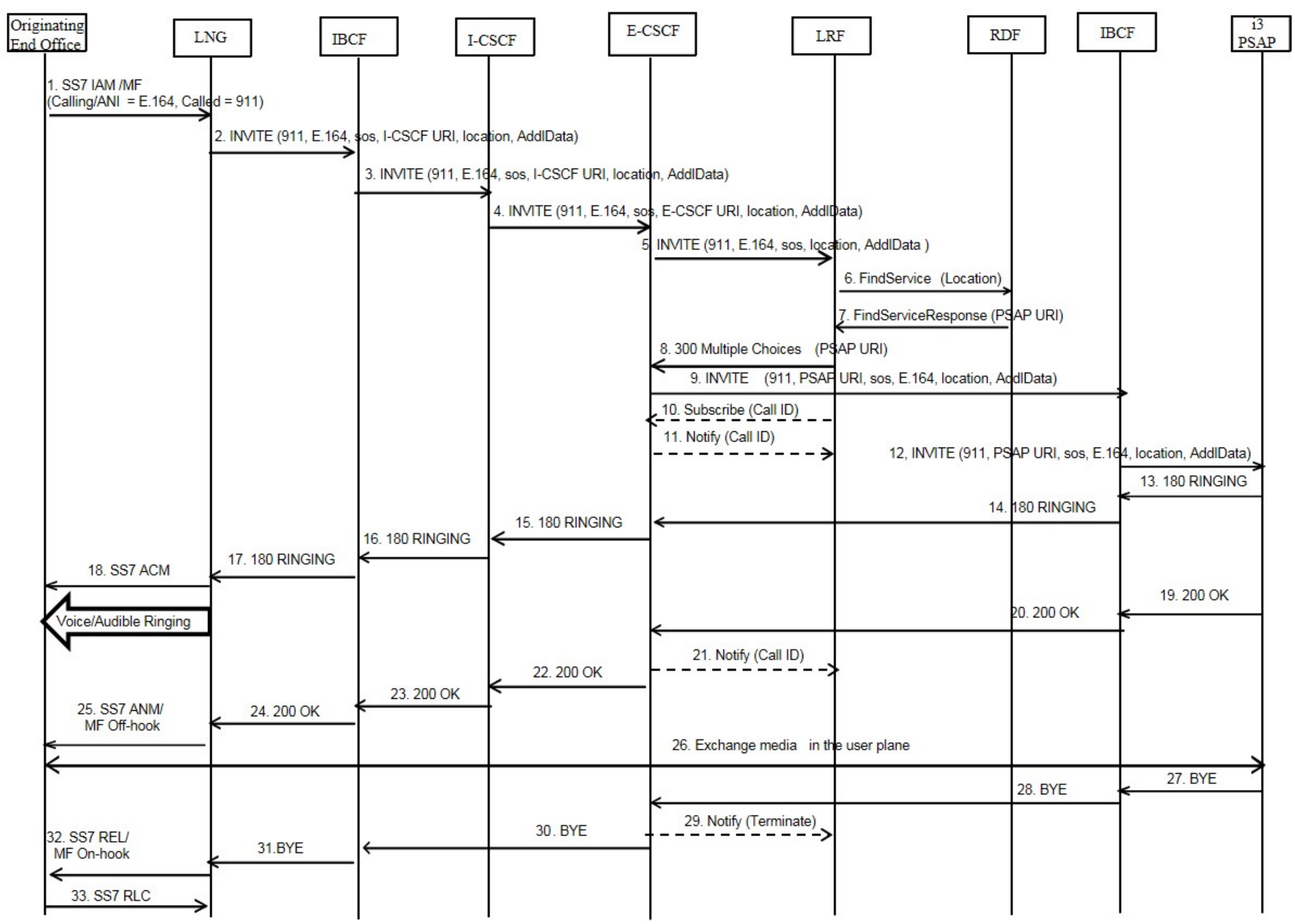

Figure 8-1: Delivery of Legacy Wireline Emergency Call Origination to i3 PSAP

Step 1. The originating end office sends an emergency call origination from a legacy wireline caller to the LNG over an MF or SS7-supported trunk group. The call setup signaling includes the caller's telephone number (in E.164 format) and the digits "911".

Step 2. The LNG uses the E.164 number received in incoming signaling to query a local location database/server that contains static TN-to-location mappings and obtains the location for the call, as described in NENA-STA-010.2 [Ref 27]. The LNG then uses this location information to query an i3 Emergency Call Routing Function (ECRF) to obtain the Route URI associated with the I-CSCF in the IMS-based NG9-1-1 Emergency Services Network (not shown). The LNG also creates an Additional Data structure per NENA-STA-010.2 and passes it forward "by-value". The LNG interworks the incoming MF/SS7 signaling to SIP, populating the calling (E.164) number in the From and PAI headers, "911" (expressed as a URI) in the To header, and a service URN of urn:service:sos in the Request-URI. The outgoing SIP INVITE message also includes a Call-Info header that contains a cid that points to the Additional Data in the body of the SIP INVITE, as well as a Geolocation header that contains a cid that points to the location information (i.e., the PIDF-LO[13]) in the body of the SIP INVITE message, and a Geolocation-Routing header set to "yes". The LNG forwards this SIP INVITE message to the (ingress) IBCF.

Step 3. The (ingress) IBCF forwards the SIP INVITE message to the I-CSCF.

Step 4. The I-CSCF forwards the SIP INVITE message to the pre-configured E-CSCF. The I-CSCF does not add itself to the Record-Route header.

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

Step 6. The LRF queries the RDF with the location and the emergency service URN (urn:service:sos) received in the SIP INVITE message from the E-CSCF.

Step 7. The RDF returns a Route URI. In this example, the Route URI is associated with an i3 PSAP that is served by the IMS-based NG9-1-1 Emergency Services Network.

Step 8. The LRF redirects the call back to the E-CSCF, passing the Route (PSAP) URI.

Step 9. The E-CSCF generates an outgoing SIP INVITE message, using the information received from the LNG and the LRF, and forwards it to the IBCF. The SIP INVITE message contains "911" (expressed as a URI) in the To header, the PSAP URI in the Route header, the sos service URN in the Request-URI, the E.164 number in the From and P-Asserted-Identity headers, and a message body that contains the LbyV, Additional Data (by value) and the SDP. The SIP INVITE also contains a pointer to the LbyV in the Geolocation header, a Geolocation-Routing header set to "yes", and a pointer(s) to the Additional Data in the Call-Info header(s).

Step 10. (Optional) The LRF may subscribe to the state of the call.

Step 11. (Conditional on Step 10) The E-CSCF sends an initial notification of the state.

Step 12. The IBCF forwards the SIP INVITE to the i3 PSAP.

Step 13. An indication that the call taker is being alerted is returned by the i3 PSAP to the (egress) IBCF (using a SIP 180 RINGING message).

Step 14. The (egress) IBCF passes the SIP 180 RINGING message to the E-CSCF.

Step 15. The E-CSCF passes the SIP 180 RINGING message to the I-CSCF.

Step 16. The I-CSCF passes the SIP 180 RINGING message to the (ingress) IBCF.

Step 17. The (ingress) IBCF passes the SIP 180 RINGING message to the LNG.

[13] Defined in RFC 4119 [Ref 16], updated by RFC 5139 [Ref 8] and RFC 5491 [Ref 10]).

Step 18. The LNG interworks the SIP 180 RINGING message to an SS7 ACM (if the call was delivered to it over an SS7-supported trunk group) and returns it to the originating end office. The LNG also generates audible ringing toward the caller.

Step 19. When the PSAP answers the call, it returns a SIP 200 OK message to the (egress) IBCF.

Step 20. The (egress) IBCF passes the SIP 200 OK message to the E-CSCF.

Step 21. (Conditional on Step 10) The E-CSCF sends a notification to the LRF updating the call state.

Step 22. The E-CSCF passes the SIP 200 OK message to the I-CSCF.

Step 23. The I-CSCF passes the SIP 200 OK message to the (ingress) IBCF.

Step 24. The (ingress) IBCF passes the SIP 200 OK message to the LNG.

Step 25. The LNG maps the SIP 200 OK message to an SS7 ANM message or MF off-hook signal to the originating end office.

Step 26. At this point a two-way connection is established between the caller and the PSAP.

Step 27. At some point the call is terminated. In this call flow, the PSAP terminates the call and sends a SIP BYE message to the (egress) IBCF.

Step 28. The SIP BYE is passed from the (egress) IBCF to the E-CSCF.

Step 29. (Conditional on Step 10) The E-CSCF then notifies the LRF that the call has terminated, provided the E-CSCF added itself to the Record-Route..

Step 30. The E-CSCF passes the SIP BYE message to the (ingress) IBCF.

Step 31. The (ingress) IBCF passes the SIP BYE message to the LNG.

Step 32. The LNG maps the SIP BYE message to an SS7 REL message or an MF on-hook indication and sends it to the originating end office.

Step 33. Upon receiving an SS7 REL message, the originating end office sends an SS7 RLC message to the LNG.

8.1.2 Delivery of Legacy Wireline Emergency Call Origination to Legacy PSAP

The call flow provided in Figure 8-2 illustrates a scenario where a legacy wireline emergency call is delivered by a legacy origination network via SS7 or MF trunks to an IMS-based NG9-1-1 Emergency Services Network. The call is delivered to an i3 LNG on the ingress side of the IMS-based NG9-1-1 Emergency Services Network with an E.164 number as the SS7 Calling Party Number/MF ANI and the digits “911” as the called number. This call flow assumes that the LNG will use the E.164 number to query a local location server/database that contains static TN-to-location mappings to obtain the routing/dispatch location for the call. This location information is then passed “by-value” to the IMS-based NG9-1-1 Emergency Services Network. The location is used by the LRF to query the RDF for call routing information. This call flow assumes that the Route URI that is returned by the RDF is the URI associated with a legacy PSAP, and that the call is forwarded via an IBCF to an i3 LPG with the LbyV and Additional Data (by-value) that was provided to the IMS-based NG9-1-1 Emergency Services Network by the LNG.

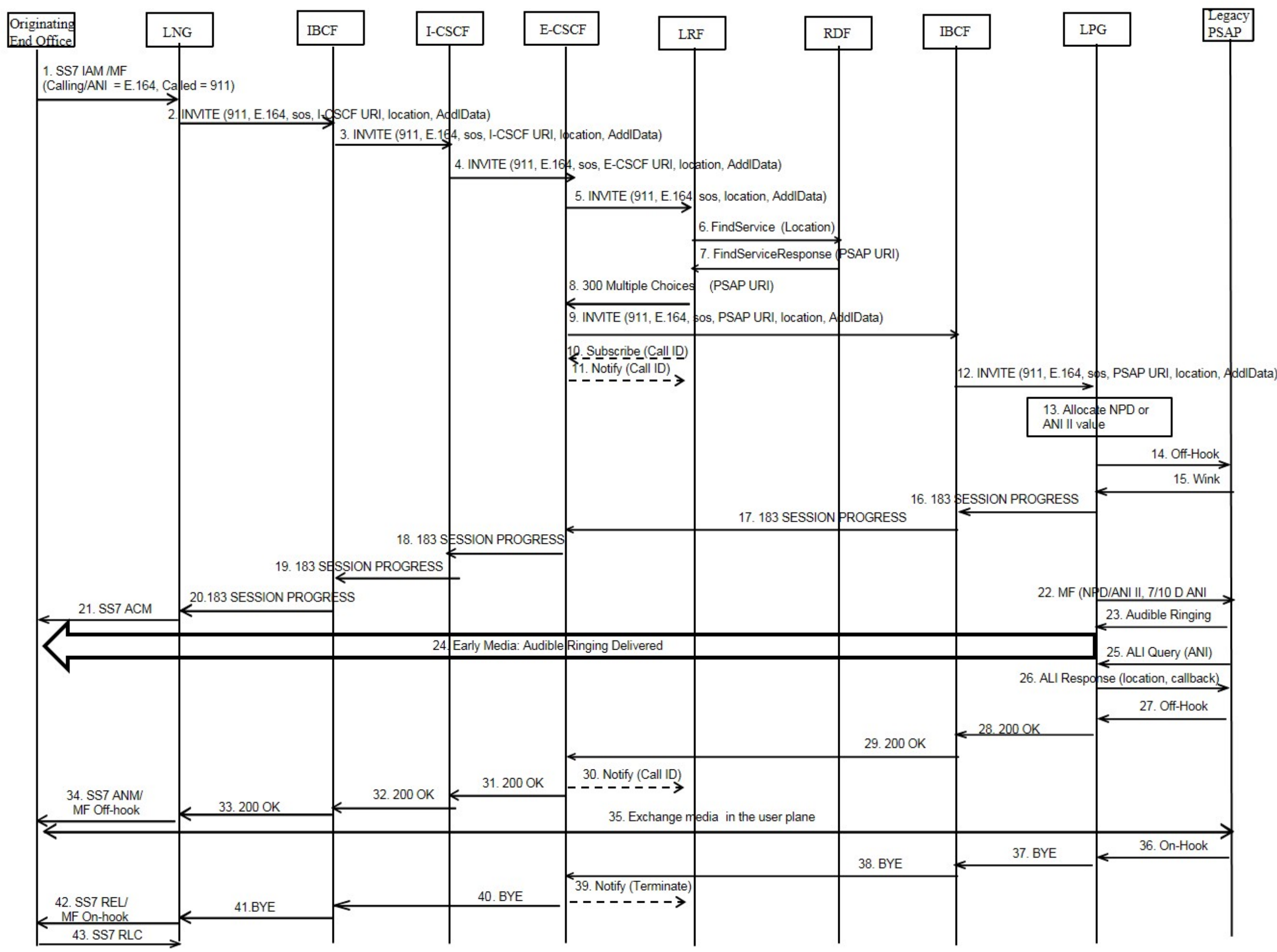

Figure 8-2: Delivery of Legacy Wireline Emergency Call Origination to Legacy PSAP

Step 1. The originating end office sends an emergency call origination from a legacy wireline caller to the LNG over an MF or SS7-supported trunk group. The call setup signaling includes the caller's telephone number (in E.164 format) and the digits "911".

Step 2. The LNG uses the E.164 number received in incoming signaling to query a local location database/server that contains static TN-to-location mappings and obtains the location for the call, as described in NENA-STA-010.2 [Ref 27]. The LNG then uses this location information to query an i3 ECRF to obtain the Route URI associated with the I-CSCF in the IMS-based NG9-1-1 Emergency Services Network (not shown). The LNG also creates an Additional Data structure per NENA-STA-010.2 and passes it forward "by-value". The LNG interworks the incoming MF/SS7 signaling to SIP, populating the calling (E.164) number in the From and PAI headers, "911" (expressed as a URI) in the To header, and a service URN of urn:service:sos in the Request-URI. The outgoing SIP INVITE message also contains a Call-Info header that contains a cid that points to the Additional Data in the body of the SIP INVITE, as well as a Geolocation header that contains a cid that points to the location information (i.e., the PIDF-LO) in the body of the SIP INVITE message, and a Geolocation-Routing header set to "yes". The LNG forwards this SIP INVITE message to the (ingress) IBCF.

Step 3. The (ingress) IBCF forwards the SIP INVITE message to the I-CSCF.

Step 4. The I-CSCF forwards the SIP INVITE to the pre-configured E-CSCF.

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

Step 6. The LRF queries the RDF with the location and the emergency service URN (urn:service:sos) received in the SIP INVITE message from the E-CSCF.

Step 7. The RDF returns a Route URI. In this example, the Route URI is associated with a legacy PSAP that is served by the IMS-based NG9-1-1 Emergency Services Network.

Step 8. The LRF redirects the call back to the E-CSCF, passing the Route (PSAP) URI.

Step 9. The E-CSCF generates an outgoing SIP INVITE message, using the information received from the LNG and the LRF, and forwards it to the (egress) IBCF. The SIP INVITE message contains the E.164 number in the From and P-Asserted-Identity headers, "911" (expressed as a URI) in the To header, the PSAP URI in the Route header, the sos service URN in the Request-URI, and a message body that contains the LbyV , Additional Data (by-value) and the SDP. The SIP INVITE also contains a pointer to the LbyV in the Geolocation header, a Geolocation-Routing header set to "yes", and a pointer(s) to the Additional Data in the Call-Info header(s).

Step 10. (Optional) The LRF may subscribe to the state of the call.

Step 11. (Conditional on Step 10) The E-CSCF sends an initial notification of the state.

Step 12. The (egress) IBCF forwards the SIP INVITE message to the LPG.

Step 13. The LPG determines, based on provisioning, whether the PSAP associated with the received PSAP URI supports a Traditional MF or Enhanced MF interface. Depending on the type of interface supported by the PSAP, the LPG assigns an appropriate NPD or ANI II value to the call.

Step 14. The LPG generates an off-hook signal toward the legacy PSAP.

Step 15. The legacy PSAP returns a wink signal back to the LPG.

Step 16. The LPG generates a 183 Session Progress message and sends it to the (egress) IBCF.

Step 17. The (egress) IBCF passes the 183 Session Progress message to the E-CSCF.

Step 18. The E-CSCF passes the 183 Session Progress message to the I-CSCF.

Step 19. The I-CSCF passes the 183 Session Progress message to the (ingress) IBCF.

Step 20. The (ingress) IBCF passes the 183 Session Progress message to the LNG.

Step 21. The LNG maps the 183 Session Progress message to an SS7 ACM (assuming that the call was received by the LNG over an SS7-supported trunk group) and passes it to the originating end office.

Step 22. The LPG maps the SIP signaling from the incoming INVITE message to the outgoing Traditional or Enhanced MF signaling sequences and forwards the call to the legacy PSAP. The MF signaling includes an NPD + 7-digit calling number/ANI (derived from the E.164 number received in incoming signaling) or II digits + 10-digit calling number/ANI, as appropriate for the PSAP interface.

Step 23. Audible ringing is returned by the legacy PSAP to the LPG.

Step 24. Audible ringing is passed to the originating end office/caller.

Step 25. The legacy PSAP sends a location query to the LPG using a NENA-defined ALI query protocol. The ALI query includes the 10-digit calling number/ANI received in Step 22. (Note that this can happen any time after Step 22.)

Step 26. The LPG returns an ALI response to the legacy PSAP that includes location information, a callback number and other information (e.g., class of service), as appropriate for the interface.

Step 27. When the PSAP answers the call, it returns an off-hook signal to the LPG.

Step 28. In response to the off-hook signal, the LPG generates a SIP 200 OK message and passes it to the (egress) IBCF.

Step 29. The (egress) IBCF passes the SIP 200 OK message to the E-CSCF.

Step 30. (Conditional on Step 10) The E-CSCF sends a notification to the LRF updating the call state.

Step 31. The E-CSCF passes the SIP 200 OK message to the I-CSCF.

Step 32. The I-CSCF passes the SIP 200 OK message to the (ingress) IBCF.

Step 33. The (ingress) IBCF passes the 200 OK message to the LNG.

Step 34. The LNG maps the SIP 200 OK message to an SS7 ANM message or MF off-hook signal to the originating end office.

Step 35. At this point a two-way connection is established between the caller and the PSAP.

Step 36. At some point the call is terminated. In this call flow, the PSAP terminates the call and sends an on-hook indication to the LPG.

Step 37. The LPG maps the on-hook indication to a SIP BYE message and sends the SIP BYE message to the (egress) IBCF.

Step 38. The (egress) IBCF sends the SIP BYE message to the E-CSCF.

Step 39. (Conditional on Step 10) The E-CSCF then notifies the LRF that the call has terminated.

Step 40. The E-CSCF passes the SIP BYE message to the (ingress) IBCF.

Step 41. The (ingress) IBCF passes the SIP BYE message to the LNG.

Step 42. The LNG maps the SIP BYE message to an SS7 REL message or an MF on-hook indication, as appropriate, and sends it to the originating end office.

Step 43. Upon receiving an SS7 REL message, the originating end office sends an SS7 RLC message to the LNG.

8.2 Legacy CMRS Origination to i3 and Legacy PSAPs

8.2.1 Delivery of Legacy Wireless Emergency Call Origination to i3 PSAP Using WCM

The call flow provided in Figure 8-3 illustrates a scenario where a legacy wireless emergency call is delivered by a legacy origination network via SS7 or MF trunks to an IMS-based NG9-1-1 Emergency Services Network using WCM. The call is delivered by the Mobile Switching Center (MSC) to an i3 LNG with an ESRK signaled as the SS7 Calling Party Number/MF ANI and the digits “911” as the called number. This call flow assumes that the LNG will determine the routing location for the call using local mappings based on the ESRK, and that it will also use the ESRK to query a Location Server (i.e., MPC/GMLC) in the legacy wireless network, using the E2 protocol, to obtain the dispatch location and callback number for the call. The LNG uses the routing location to query an ECRF (not shown) and then uses the URI provided in the ECRF response to route the call via an (ingress) IBCF to an I-CSCF in the IMS-based NG9-1-1 Emergency Services Network. The call is delivered to the IMS-based NG9-1-1 Emergency Services Network with a callback number, LbyR (i.e., a location URI), and Additional Data by reference (i.e., with a reference URI in a Call-Info header). The LRF uses the routing location and the sos service URN to query the RDF. This call flow assumes that the Route URI that is returned by the RDF is the URI associated with an i3 PSAP. The LRF returns the Route URI to the E-CSCF and the call is delivered to the i3 PSAP with location (i.e., LbyR), a callback number, and Additional Data (by reference).

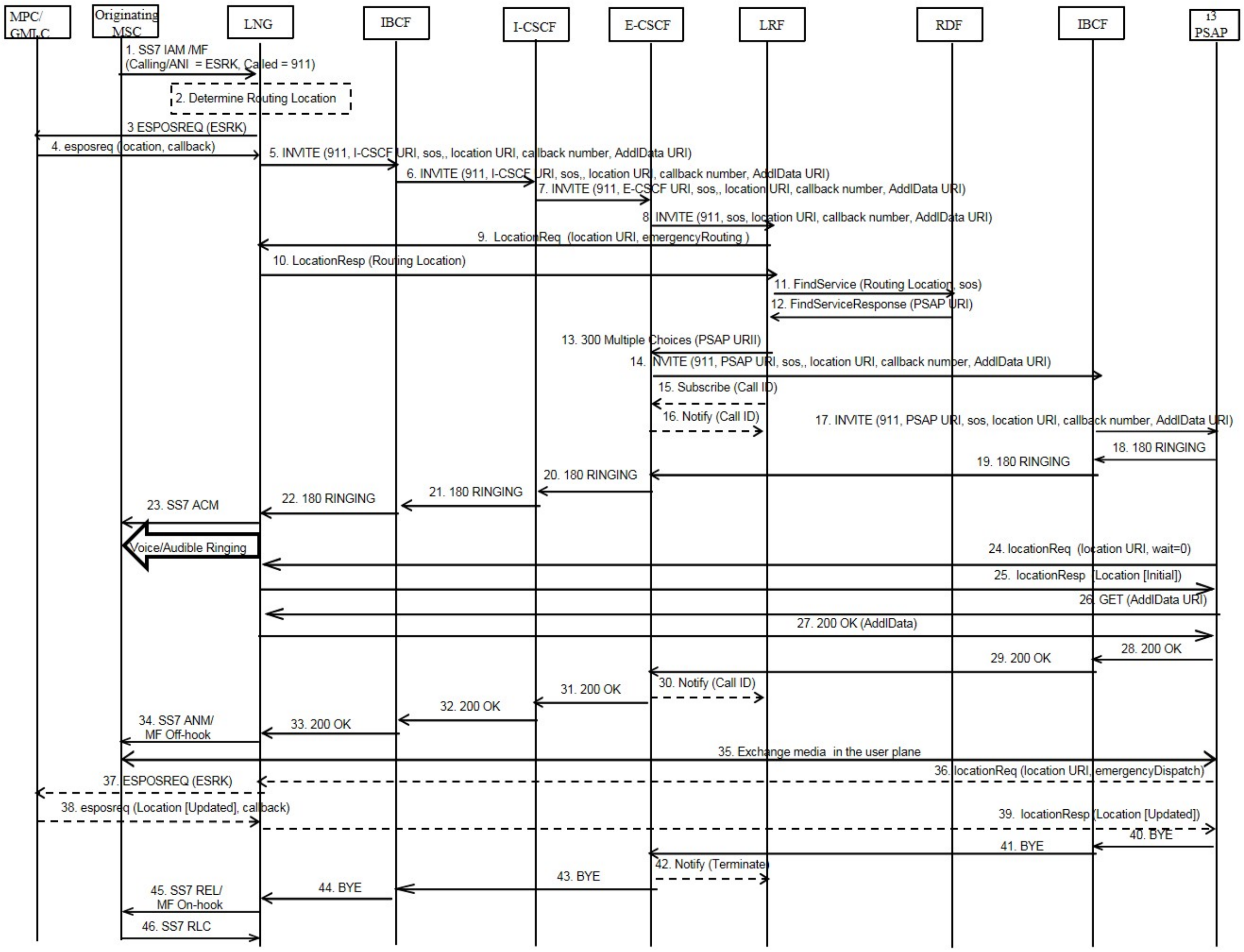

Figure 8-3: Delivery of Legacy Wireless Emergency Call Origination to i3 PSAP Using WCM

Step 1. The originating MSC sends an emergency call origination from a legacy wireless caller to an i3 LNG over an MF or SS7-supported trunk group. The call setup signaling includes the ESRK (as the calling number) and the digits "911" (as the called number).

Step 2. The LNG accesses pre-provisioned data that maps the ESRK received in incoming signaling from the MSC to a routing location chosen so that it will route to the target PSAP associated with the ESRK (i.e., the Associated Location). The LNG uses the routing location to query an i3 ECRF to obtain the Route URI associated with the I-CSCF in the IMS-based NG9-1-1 Emergency Services Network (not shown).

Step 3. The LNG queries an MPC/GMLC in the legacy wireless originating network to obtain callback and initial dispatch location information for the call. In this example, the LNG uses the E2 protocol. Note that Steps 2 and 3 may be performed in parallel, depending on the implementation.

Step 4. The MPC/GMLC responds with the callback number and initial dispatch location, as well as non-location information (e.g., class of service).

Step 5. The LNG generates an outgoing SIP INVITE message, populating the callback number obtained from the MPC/GMLC in the From and PAI headers, "911" (expressed as a URI) in the To header, a service URN of urn:service:sos in the Request-URI and the I-CSCF URI obtained from the ECRF in the Route header. The outgoing SIP INVITE message also includes a Geolocation header that contains a location reference URI, and a Geolocation-Routing header set to “yes”. The LNG creates an Additional Data structure per NENA-STA-010.2 and passes it forward “by-reference” by including a Call-Info header with a reference URI in the outgoing SIP INVITE message. The LNG forwards this SIP INVITE message to the (ingress) IBCF.

Step 6. The (ingress) IBCF forwards the SIP INVITE message to the I-CSCF.

Step 7. The I-CSCF forwards the SIP INVITE to the pre-configured E-CSCF.

Step 8. The E-CSCF forwards the SIP INVITE to the LRF.

Step 9. Since the SIP INVITE contains a LbyR, the LRF generates a de-reference request to the element identified in the location URI (i.e., the LNG) to obtain the routing location for the call. This example illustrates the use of HELD as the de-referencing protocol with a responseTime parameter value of “emergencyRouting”.

Step 10. The LNG responds to the de-reference request by returning the routing location obtained in Step 2.

Step 11. The LRF queries the RDF with the routing location received in Step 10 and the emergency service URN (urn:service:sos) received in the SIP INVITE message from the E-CSCF.

Step 12. The RDF returns a Route URI. In this example, the Route URI is associated with an i3 PSAP that is served by the IMS-based NG9-1-1 Emergency Services Network.

Step 13. The LRF redirects the call back to the E-CSCF, passing the Route (PSAP) URI obtained in Step 12.

Step 14. The E-CSCF generates an outgoing SIP INVITE message, using the information received from the LNG and the LRF, and forwards it to the (egress) IBCF. The SIP INVITE message contains the callback number received from the LNG in the From and P-Asserted-Identity headers, “911” (expressed as a URI) in the To header, the PSAP URI in the Route header, the sos service URN in the Request-URI, the location URI (LbyR) in the Geolocation header, a Geolocation-Routing header set to “yes”, and a Call-Info header that contains the Additional Data URI received from the LNG.

Step 15. (Optional) The LRF may subscribe to the state of the call.

Step 16. (Conditional on Step 15) The E-CSCF sends an initial notification of the state.

Step 17. The (egress) IBCF forwards the SIP INVITE to the i3 PSAP.

Step 18. An indication that the call taker is being alerted is returned by the i3 PSAP to the (egress) IBCF (using a SIP 180 RINGING message).

Step 19. The (egress) IBCF passes the SIP 180 RINGING message to the E-CSCF.

Step 20. The E-CSCF passes the SIP 180 RINGING message to the I-CSCF.

Step 21. The I-CSCF passes the SIP 180 RINGING message to the (ingress) IBCF.

Step 22. The (ingress) IBCF passes the SIP 180 RINGING message to the LNG.

Step 23. The LNG interworks the SIP 180 RINGING message to an SS7 ACM (if the call was delivered to it over an SS7-supported trunk group) and returns it to the originating MSC. The LNG also generates audible ringing toward the caller.

Step 24. In this example, the SIP INVITE contains a location URI, so the i3 PSAP queries the LNG (as identified in the location URI) for initial dispatch location (i.e., responseTime contains a wait timer value of “0”).

Step 25. The LNG supplies the initial dispatch location information from Step 4 to the PSAP. The initial dispatch location information is displayed at the PSAP CPE.

Step 26. In this example, the SIP INVITE contains an Additional Data URI, so the i3 PSAP queries the LNG (as identified in the URI) for Additional Data using an HTTPS GET operation.

Step 27. The LNG provides the requested Additional Data in a 200 OK response.[14]

Step 28. When the PSAP answers the call, it returns a SIP 200 OK message to the (egress) IBCF.

Step 29. The (egress) IBCF passes the SIP 200 OK message to the E-CSCF.

Step 30. (Conditional on Step 15) The E-CSCF sends a notification to the LRF updating the call state.

Step 31. The E-CSCF passes the SIP 200 OK message to the I-CSCF.

Step 32. The I-CSCF passes the SIP 200 OK message to the (ingress) IBCF.

Step 33. The (ingress) IBCF passes the SIP 200 OK message to the LNG.

Step 34. The LNG maps the SIP 200 OK message to an SS7 ANM message or MF off-hook signal to the originating MSC.

Step 35. At this point a two-way connection is established between the caller and the PSAP.

Step 36. (Optional) The PSAP queries the LNG (as identified in the location URI) for updated (dispatch) location information (responseTime parameter = "emergencyDispatch" in this example).

Step 37. (Conditional on Step 36) The LNG queries the MPC/GMLC for updated (dispatch) location. (Note that the value of the responseTime parameter [emergencyDispatch or a specific time value] will be used by the LRF to determine whether to query the MPC/GMLC.)

Step 38. (Conditional on Step 37) The MPC/GMLC returns updated (dispatch) location information (and the callback number) to the LNG.

Step 39. (Conditional on Step 36) The LNG supplies updated (dispatch) location to the PSAP for display at the PSAP.

Step 40. At some point the call is terminated. In this call flow, the PSAP terminates the call and sends a SIP BYE message to the (egress) IBCF.

Step 41. The SIP BYE is passed from the (egress) IBCF to the E-CSCF.

Step 42. (Conditional on Step 15) The E-CSCF then notifies the LRF that the call has terminated.

Step 43. The E-CSCF passes the SIP BYE message to the (ingress) IBCF.

Step 44. The (ingress) IBCF passes the SIP BYE message to the LNG.

Step 45. The LNG maps the SIP BYE message to an SS7 REL message or an MF on-hook indication and sends it to the originating MSC.

Step 46. Upon receiving an SS7 REL message, the originating MSC sends an SS7 RLC message to the LNG.

8.2.2 Delivery of Legacy Wireless Emergency Call Origination to Legacy PSAP Using WCM

The call flow provided in Figure 8-4 illustrates a scenario where a legacy wireless emergency call is delivered by a legacy origination network via SS7 or MF trunks to an IMS-based NG9-1-1 Emergency Services Network using WCM. The call is delivered by the Mobile Switching Center (MSC) to an i3 LNG with an ESRK signaled as the SS7 Calling Party Number/MF ANI and the digits "911" as the called number. This call flow assumes that the LNG will determine the routing location for the call using local mappings based on the ESRK, and that it will also use the ESRK to query a Location Server (i.e., MPC/GMLC) in the legacy wireless network, using the E2 protocol, to obtain the dispatch location for the call. The LNG uses the routing location to query an ECRF (not shown) and then uses the URI provided in the ECRF response to route the call via an (ingress) IBCF to an I-CSCF in the IMS-based NG9-1-1 Emergency Services Network. The call is delivered to the IMS-based NG9-1-1 Emergency

[14] Note that Steps 24 through 27 can happen any time after Step 17, and that Steps 24 and 25 can be performed either before or after Steps 26 and 27.

Services Network with a callback number, LbyR (i.e., a location URI), and Additional Data by reference (i.e., with a reference URI in a Call-Info header). The LRF uses the routing location and the sos service URN to query the RDF. This call flow assumes that the Route URI that is returned by the RDF is the URI associated with a legacy PSAP, and that the call is forwarded via an (egress) IBCF to an i3 LPG with the callback number, LbyR and Additional Data (by-reference) that was provided to the IMS-based NG9-1-1 Emergency Services Network by the LNG.

The call flow depicted in Figure 8-4 assumes that the LPG generates a pANI for the call and, based on per-PSAP provisioning, associates an appropriate Numbering Plan Digit (NPD) or ANI II value with the call (depending on whether the PSAP supports a Traditional MF interface or an Enhanced MF interface).

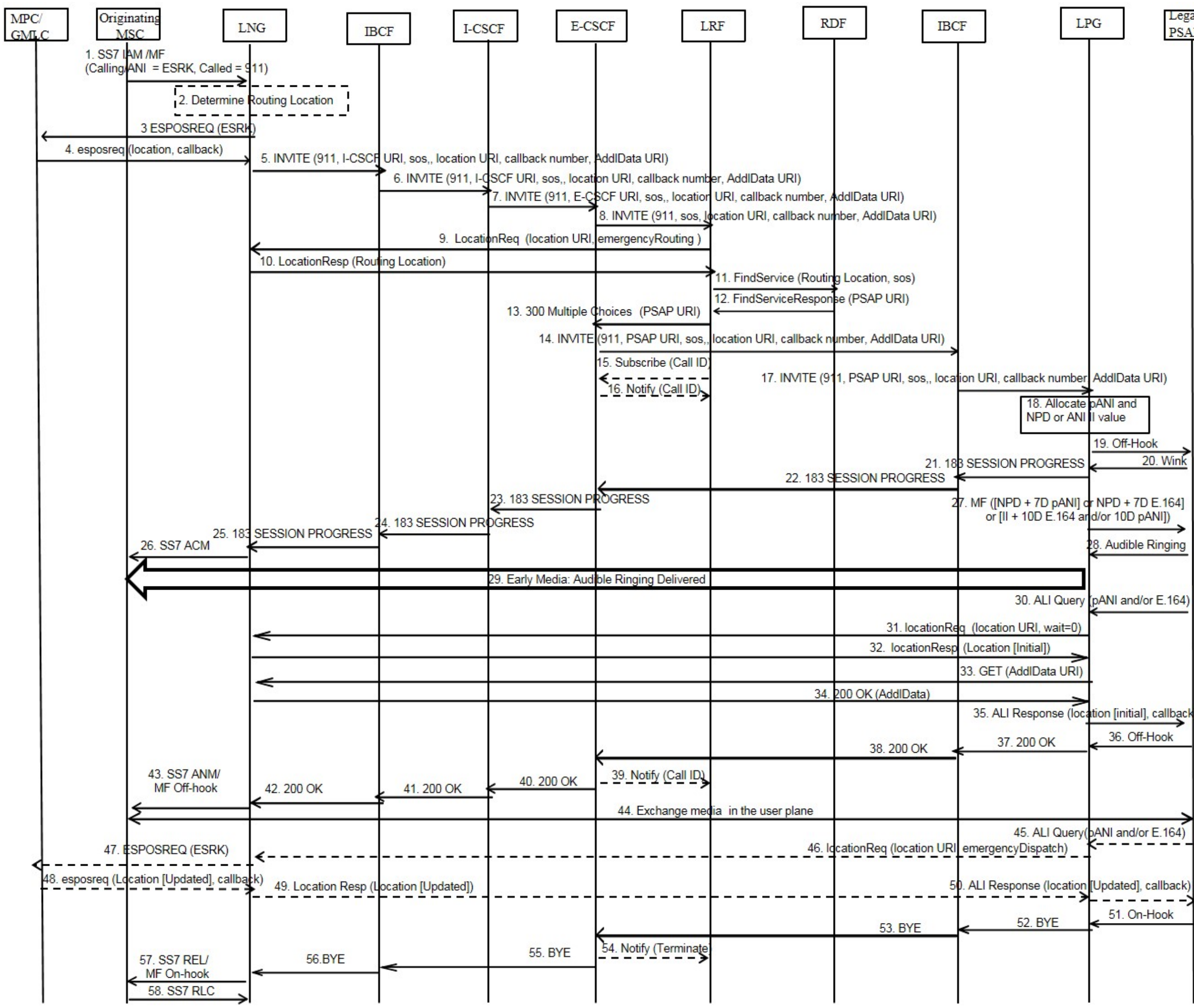

Figure 8-4: Delivery of Legacy Wireless Emergency Call Origination to Legacy PSAP Using WCM

Step 1. The originating MSC sends an emergency call origination from a legacy wireless caller to an i3 LNG over an MF or SS7-supported trunk group. The call setup signaling includes the ESRK (as the calling number) and the digits “911” (as the called number).

Step 2. The LNG accesses pre-provisioned data that maps the ESRK received in incoming signaling from the MSC to a routing location chosen so that it will route to the target PSAP associated with the ESRK (i.e., the Associated Location). The LNG uses the routing location to query an i3 ECRF to obtain the Route URI associated with the I-CSCF in the IMS-based NG9-1-1 Emergency Services Network (not shown).

Step 3. The LNG queries an MPC/GMLC in the legacy wireless originating network to obtain callback and initial dispatch location information for the call. In this example, the LNG uses the E2 protocol. Note that Steps 2 and 3 may be performed in parallel, depending on the implementation.

Step 4. The MPC/GMLC responds with the callback number and initial dispatch location, as well as non-location information (e.g., class of service).

Step 5. The LNG generates an outgoing SIP INVITE message, populating the callback number obtained from the MPC/GMLC in the From and PAI headers, "911" (expressed as a URI) in the To header, a service URN of urn:service:sos in the Request-URI, and the I-CSCF URI obtained from the ECRF in the Route header. The outgoing SIP INVITE message also includes a Geolocation header that contains a location reference URI, and a Geolocation-Routing header set to "yes". The LNG creates an Additional Data structure per NENA-STA-010.2 and passes it forward "by-reference" by including a Call-Info header with a reference URI in the outgoing SIP INVITE message. The LNG forwards this SIP INVITE message to the (ingress) IBCF.

Step 6. The (ingress) IBCF forwards the SIP INVITE message to the I-CSCF.

Step 7. The I-CSCF forwards the SIP INVITE to the pre-configured E-CSCF.

Step 8. The E-CSCF forwards the SIP INVITE to the LRF.

Step 9. Since the SIP INVITE contains a LbyR, the LRF generates a de-reference request to the element identified in the location URI (i.e., the LNG) to obtain the routing location for the call. This example illustrates the use of HELD as the de-referencing protocol, with a responseTime parameter value of "emergencyRouting".

Step 10. The LNG responds to the de-reference request by returning the routing location obtained in Step 2.

Step 11. The LRF queries the RDF with the routing location received in Step 10 and the emergency service URN (urn:service:sos) received in the SIP INVITE message from the E-CSCF.

Step 12. The RDF returns a Route URI. In this example, the Route URI is associated with a legacy PSAP that is served by the IMS-based NG9-1-1 Emergency Services Network.

Step 13. The LRF redirects the call back to the E-CSCF, passing the Route (PSAP) URI.

Step 14. The E-CSCF generates an outgoing SIP INVITE message, using the information received from the LNG and the LRF, and forwards it to the (egress) IBCF. The SIP INVITE message contains the callback number received from the LNG in the From and P-Asserted Identity headers, "911" (expressed as a URI) in the To header, the PSAP URI in the Route header, the sos service URN in the Request-URI, the location URI (LbyR) in the Geolocation header, a Geolocation-Routing header set to "yes", and a Call-Info header that contains the Additional Data URI received from the LNG.

Step 15. (Optional) The LRF may subscribe to the state of the call.

Step 16. (Conditional on Step 15) The E-CSCF sends an initial notification of the state.

Step 17. The (egress) IBCF forwards the SIP INVITE to the LPG.

Step 18. The LPG determines, based on provisioning, whether the PSAP associated with the received PSAP URI supports a Traditional MF or Enhanced MF interface. Depending on the type of interface supported by the PSAP, the LPG generates a pANI and assigns an appropriate NPD or ANI II value to the call, following the procedures specified in Section 7.2.2 of NENA-STA-010.2.

Step 19. The LPG generates an off-hook signal toward the legacy PSAP.

Step 20. The legacy PSAP returns a wink signal back to the LPG.

Step 21. The LPG generates a 183 Session Progress message and sends it to the (egress) IBCF.

Step 22. The (egress) IBCF passes the 193 Session Progress message to the E-CSCF.

Step 23. The E-CSCF passes the 183 Session Progress message to the I-CSCF.

Step 24. The I-CSCF passes the 183 Session Progress message to the (ingress) IBCF.

Step 25. The (ingress) IBCF passes the 183 Session Progress message to the LNG.

Step 26. The LNG maps the 183 Session Progress message to an SS7 ACM (assuming that the call was received by the LNG over an SS7-supported trunk group) and passes it to the originating MSC.

Step 27. The LPG delivers the call to the legacy PSAP, mapping the SIP signaling from the incoming INVITE message to the outgoing Traditional or Enhanced MF signaling sequences.

- For PSAPs that support a Traditional MF interface where delivery of callback information is preferred, the LPG will map the information received in the From/P-Asserted-Identity headers of the incoming SIP INVITE message, adding an appropriate NPD digit (i.e., the NPD + 7D E.164 number), to the MF ANI sequence KP + NPD + NXX XXXX + ST.
- For PSAPs that support a Traditional MF interface where delivery of location information is preferred, the LPG will populate the pANI it generated, along with an appropriate NPD digit (i.e., the NPD + 7D pANI) in the MF ANI sequence KP + NPD + NXX XXXX + ST.
- For PSAPs that support an Enhanced MF interface with 10-digit delivery where delivery of callback information is preferred, the LPG will map the information received in the P-Asserted-Identity header of the SIP INVITE message along with an appropriate II value (i.e., the II digits plus the 10D E.164 number) to the MF ANI sequence KP + II + NPA NXX XXXX + ST´.
- For PSAPs that support an Enhanced MF interface with 10-digit delivery where delivery of location information is preferred, the LPG will populate the pANI it generated along with an appropriate II value (i.e., the II digits plus the 10D pANI) in the MF ANI sequence KP + II + NPA NXX XXXX + ST´.
- For PSAPs that support an Enhanced MF interface with 20-digit delivery, the LPG will populate the pANI that it generated and the information received in the PAI (i.e., the E.164 number) along with an appropriate II value in the MF sequence KP + II + NPA NXX XXXX + ST + KP + NPA NXX XXXX + ST, where the first 10-digit number is mapped from the PAI and the second 10-digit number contain the pANI.

Step 28. Audible ringing is returned by the legacy PSAP to the LPG.

Step 29. Audible ringing is passed to the originating MSC/caller.

Step 30. The legacy PSAP sends a location query to the LPG using a NENA-defined ALI query protocol. The ALI query includes the 10-digit pANI and/or the 10-digit E.164 number received in Step 27. (Note that this can happen any time after Step 27.)

Step 31. Since, in this example, LbyR was delivered to the LPG in the SIP INVITE message, the LPG sends a de-reference request to the LNG (as identified in the location URI) for initial dispatch location (i.e., responseTime contains a wait timer value of “0”).

Step 32. The LNG returns the initial dispatch location from Step 4 to the LPG in the de-reference response.

Step 33. In this example, the SIP INVITE received by the LPG contains an Additional Data URI, so the LPG queries the LNG (as identified in the URI) for Additional Data using an HTTPS GET operation.

Step 34. The LNG provides the requested Additional Data in a 200 OK response.[15]

Step 35. The LPG returns an ALI response to the legacy PSAP that includes initial dispatch location information, a callback number and other information (e.g., class of service), as appropriate for the interface.

Step 36. When the PSAP answers the call, it returns an off-hook signal to the LPG.

Step 37. In response to the off-hook signal, the LPG generates a SIP 200 OK message and passes it to the (egress) IBCF.

Step 38. The (egress) IBCF passes the SIP 200 OK message to the E-CSCF.

Step 39. The E-CSCF sends a notification to the LRF updating the call state.

Step 40. The E-CSCF passes the SIP 200 OK message to the I-CSCF.

Step 41. The I-CSCF passes the SIP 200 OK message to the (ingress) IBCF.

Step 42. The (ingress) IBCF passes the SIP 200 OK message to the LNG.

Step 43. The LNG maps the SIP 200 OK message to an SS7 ANM message or MF off-hook signal to the originating MSC.

Step 44. At this point a two-way connection is established between the caller and the PSAP.

Step 45. (Optional) The PSAP queries the LPG for updated (dispatch) location information.

Step 46. (Conditional on Step 45) The LPG sends a de-reference request to the LNG (as identified in the location URI) for updated (dispatch) location information (responseTime parameter = “emergencyDispatch” in this example).

Step 47. (Conditional on Step 46) The LNG queries the MPC/GMLC for updated (dispatch) location. (Note that the value of the responseTime parameter [emergencyDispatch or a specific time value] will be used by the LNG to determine whether to query the MPC/GMLC.)

Step 48. (Conditional on Step 47) The MPC/GMLC returns updated (dispatch) location information to the LNG.

Step 49. (Conditional on Step 46) The LNG returns the updated (dispatch) location from Step 48 to the LPG in the de-reference response.

Step 50. (Conditional on Step 45) The LRF supplies updated (dispatch) location to the PSAP for display at the PSAP.

Step 51. At some point the call is terminated. In this call flow, the PSAP terminates the call and sends an on-hook indication to the LPG.

Step 52. The LPG maps the on-hook indication to a SIP BYE message and sends the SIP BYE message to the (egress) IBCF.

Step 53. The (egress) IBCF passes the SIP BYE message to the E-CSCF.

Step 54. The E-CSCF then notifies the LRF that the call has terminated.

Step 55. The E-CSCF passes the SIP BYE message to the (ingress) IBCF.

Step 56. The (ingress) IBCF passes the SIP BYE message to the LNG.

Step 57. The LNG maps the SIP BYE message to an SS7 REL message or an MF on-hook indication, as appropriate, and sends it to the originating MSC.

Step 58. Upon receiving an SS7 REL message, the originating MSC sends an SS7 RLC message to the LNG.

[15] Note that Steps 31 through 34 can happen any time after Step 27, and that Steps 31 and 32 can be performed either before or after Steps 33 and 34.

8.2.3 Delivery of Legacy Wireless Emergency Call Origination to i3 PSAP using NCAS

The call flow provided in Figure 8-5 illustrates a scenario where a legacy wireless emergency call is delivered by a legacy origination network via SS7 or MF trunks to an IMS-based NG9-1-1 Emergency Services Network using NCAS. The call is delivered to the LNG with an ESRD/ESRK signaled in the SS7 Generic Digits Parameter (GDP) or as the MF called number, the callback number (in the form of an E.164 number) in the SS7 Calling Party Number parameter or as the MF ANI, and if the call is delivered via an SS7-supported trunk group, the digits "911" in the SS7 Called Party Number parameter. This call flow assumes that the LNG will determine the routing location for the call using local mappings based on the ESRD/ESRK received in incoming signaling from the MSC. It also assumes that the LNG will use the ESRD/ESRK and the E.164 number to query an MPC/GMLC in the legacy wireless network (using the E2 protocol) to obtain the dispatch location for the call. The LNG uses the routing location to query an ECRF (not shown) and then uses the URI provided in the ECRF response to route the call via an (ingress) IBCF to an I-CSCF in the IMS-based NG9-1-1 Emergency Services Network. The call is delivered to the IMS-based NG9-1-1 Emergency Services Network with the callback/E.164 number, LbyR (i.e., a location URI), and Additional Data by reference (i.e., with a reference URI in a Call-Info header). The LRF uses the routing location and the sos service URN to query the RDF. This call flow assumes that the Route URI that is returned by the RDF is the URI associated with an i3 PSAP. The LRF returns the Route URI to the E-CSCF and the call is delivered to the i3 PSAP with location (i.e., LbyR), the callback/E.164 number, and Additional Data (by reference).

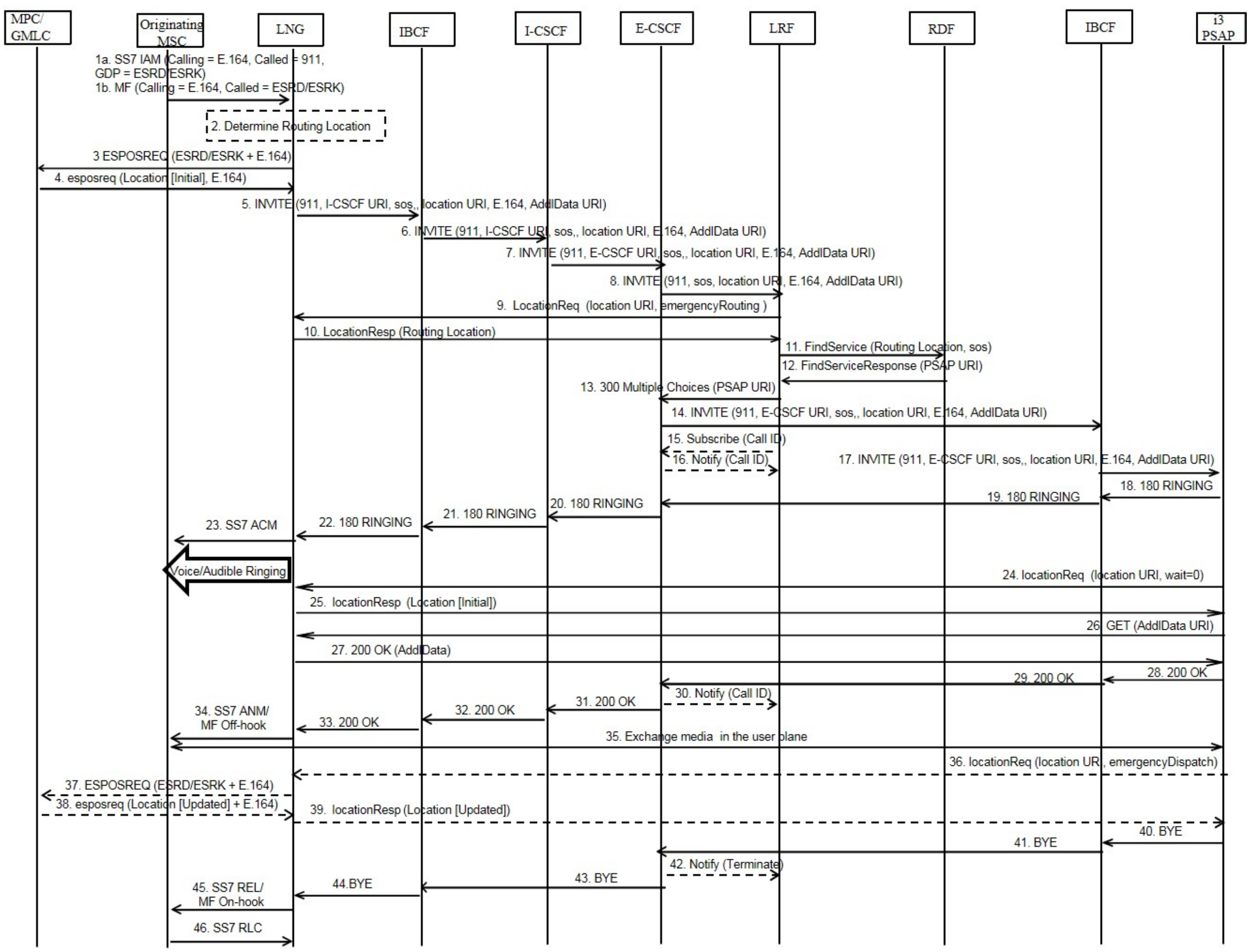

Figure 8-5: Delivery of Legacy Wireless Emergency Call Origination to i3 PSAP Using NCAS

Step 1. The originating MSC sends an emergency call origination from a legacy wireless caller to the LNG over an MF or SS7-supported trunk group.

(a) If the call is delivered over an SS7 trunk group, the call setup signaling includes the calling (E.164) number sent in the Calling Party Number parameter, the ESRD/ESRK sent in the SS7 GDP, and the digits “911” in the SS7 Called Party Number parameter.

(b) If the call is delivered over an MF trunk group, the call setup signaling includes the ESRD/ESRK signaled as the called number, and the E.164 number signaled as the ANI.

Step 2. The LNG accesses pre-provisioned data that maps the ESRD/ESRK received in incoming signaling from the MSC to a routing location chosen so that it will route to the target PSAP associated with the ESRD/ESRK (i.e., the Associated Location). The LNG uses the routing location to query an i3 ECRF to obtain the Route URI associated with the I-CSCF in the IMS-based NG9-1-1 Emergency Services Network (not shown).

Step 3. The LNG queries an MPC/GMLC in the legacy wireless originating network (using the ESRD/ESRK and the E.164 number received in incoming signaling from the MSC) to obtain initial dispatch location information for the call. In this example, the LNG uses the E2 protocol. Note that Steps 2 and 3 may be performed in parallel, depending on the implementation.

Step 4. The MPC/GMLC responds with the callback number and initial dispatch location, as well as non-location information (e.g., class of service).

Step 5. The LNG generates an outgoing SIP INVITE message, populating the E.164 number received from the MSC in the From and PAI headers, “911” (expressed as a URI) in the To header, a service URN of urn:service:sos in the Request-URI and the I-CSCF URI obtained from the ECRF in the Route header. The outgoing SIP INVITE message also includes a Geolocation header that contains a location reference URI, and a Geolocation-Routing header set to “yes”. The LNG creates an Additional Data structure per NENA-STA-010.2 and passes it forward “by-reference” by including a Call-Info header with a reference URI in the outgoing SIP INVITE message. The LNG forwards this SIP INVITE message to the (ingress) IBCF.

Step 6. The (ingress) IBCF forwards the SIP INVITE message to the I-CSCF.

Step 7. The I-CSCF forwards the SIP INVITE to the pre-configured E-CSCF.

Step 8. The E-CSCF forwards the SIP INVITE to the LRF.

Step 9. Since the SIP INVITE contains a LbyR, the LRF generates a de-reference request to the element identified in the location URI (i.e., the LNG) to obtain the routing location for the call. This example illustrates the use of HELD as the de-referencing protocol, with a responseTime parameter value of “emergencyRouting”.

Step 10. The LNG responds to the de-reference request by returning the routing location obtained in Step 2.

Step 11. The LRF queries the RDF with the routing location received in Step 10 and the emergency service URN (urn:service:sos) received in the SIP INVITE message from the E-CSCF.

Step 12. The RDF returns a Route URI. In this example, the Route URI is associated with an i3 PSAP that is served by the IMS-based NG9-1-1 Emergency Services Network.

Step 13. The LRF redirects the call back to the E-CSCF, passing the Route (PSAP) URI.

Step 14. The E-CSCF generates an outgoing SIP INVITE message, using the information received from the LNG and the LRF, and forwards it to the (egress) IBCF. The SIP INVITE message contains: the digits “911” (expressed as a URI) in the To header; the PSAP URI in the Route header; the sos service URN in the Request-URI; the E.164 number in the P-Asserted-Identity and From headers; the LbyR in the Geolocation header, a Geolocation-Routing header set to “yes”, and a pointer (i.e., reference URI) in the Call-Info header to the Additional Data structure created by the LNG.

Step 15. (Optional) The LRF may subscribe to the state of the call.

Step 16. (Conditional on Step 15) The E-CSCF sends an initial notification of the state.

Step 17. The (egress) IBCF forwards the SIP INVITE to the i3 PSAP.

Step 18. An indication that the call taker is being alerted is returned by the i3 PSAP to the (egress) IBCF (using a SIP 180 RINGING message).

Step 19. The IBCF passes the SIP 180 RINGING message to the E-CSCF.

Step 20. The E-CSCF passes the SIP 180 RINGING message to the I-CSCF.

Step 21. The I-CSCF passes the SIP 180 RINGING message to the (ingress) IBCF.

Step 22. The (ingress) IBCF passes the SIP 180 RINGING message to the LNG.

Step 23. The LNG interworks the SIP 180 RINGING message to an SS7 ACM (if the call was delivered to it over an SS7-supported trunk group) and returns it to the originating MSC. The LNG also generates audible ringing toward the caller.

Step 24. In this example, the SIP INVITE contains a location URI, so the i3 PSAP queries the LNG (as identified in the location URI) for initial dispatch location (i.e., responseTime contains a wait timer value of "0").

Step 25. The LNG supplies the initial dispatch location information from Step 4 to the PSAP. The initial display location information is displayed at the PSAP CPE.

Step 26. In this example, the SIP INVITE contains an Additional Data URI, so the i3 PSAP queries the LNG (as identified in the URI) for Additional Data using an HTTPS GET operation.

Step 27. The LNG provides the requested Additional Data in a 200 OK response.[16]

Step 28. When the PSAP answers the call, it returns a SIP 200 OK message to the (egress) IBCF.

Step 29. The (egress) IBCF passes the SIP 200 OK message to the E-CSCF.

Step 30. The E-CSCF sends a notification to the LRF updating the call state.

Step 31. The E-CSCF passes the SIP 200 OK message to the I-CSCF.

Step 32. The I-CSCF passes the SIP 200 OK message to the (ingress) IBCF.

Step 33. The (ingress) IBCF passes the SIP 200 OK message to the LNG.

Step 34. The LNG maps the SIP 200 OK message to an SS7 ANM message or MF off-hook signal to the originating MSC.

Step 35. At this point a two-way connection is established between the caller and the PSAP.

Step 36. (Optional) The PSAP queries the LNG (as identified in the location URI) for updated (dispatch) location information (responseTime parameter = "emergencyDispatch" in this example).

Step 37. (Conditional on Step 36) The LNG queries the MPC/GMLC for updated (dispatch) location. (Note that the value of the responseTime parameter [emergencyDispatch or a specific time value] will be used by the LNG to determine whether to query the MPC/GMLC.)

Step 38. (Conditional on Step 37) The MPC/GMLC returns updated (dispatch) location information (and the callback number) to the LNG.

Step 39. (Conditional on Step 36) The LNG supplies updated (dispatch) location to the PSAP for display at the PSAP.

Step 40. At some point the call is terminated. In this call flow, the PSAP terminates the call and sends a SIP BYE message to the (egress) IBCF.

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[16] Note that Steps 24 through 27 can happen any time after Step 17, and that Steps 24 and 25 can be performed either before or after Steps 26 and 27.

Step 41. The SIP BYE is passed from the (egress) IBCF to the E-CSCF.

Step 42. The E-CSCF then notifies the LRF that the call has terminated.

Step 43. The E-CSCF passes the SIP BYE message to the (ingress) IBCF.

Step 44. The (ingress) IBCF passes the SIP BYE message to the LNG.

Step 45. The LNG maps the SIP BYE message to an SS7 REL message or an MF on-hook indication and sends it to the originating MSC.

Step 46. Upon receiving an SS7 REL message, the originating MSC sends an SS7 RLC message to the LNG.

8.2.4 Delivery of Legacy Wireless Emergency Call Origination to Legacy PSAP using NCAS

The call flow provided in Figure 8-6 illustrates a scenario where a legacy wireless emergency call is delivered by a legacy origination network via SS7 or MF trunks to an IMS-based NG9-1-1 Emergency Services Network using NCAS. The call is delivered to the LNG with an ESRD/ESRK signaled in the SS7 Generic Digits Parameter (GDP) or as the MF called number, the callback number (in the form of an E.164 number) in the SS7 Calling Party Number parameter or as the MF ANI, and if the call is delivered via an SS7-supported trunk group, the digits “911” in the SS7 Called Party Number parameter. This call flow assumes that the LNG will determine the routing location for the call using local mappings based on the ESRD/ESRK received in incoming signaling from the MSC. It also assumes that the LNG will use the ESRD/ESRK and the E.164 number to query an MPC/GMLC in the legacy wireless network (using the E2 protocol) to obtain the dispatch location for the call. The LNG uses the routing location to query an ECRF (not shown) and then uses the URI provided in the ECRF response to route the call via an (ingress) IBCF to an I-CSCF in the IMS-based NG9-1-1 Emergency Services Network. The call is delivered to the IMS-based NG9-1-1 Emergency Services Network with the callback/E.164 number, LbyR (i.e., a location URI), and Additional Data by reference (i.e., with a reference URI in a Call-Info header). The LRF uses the routing location and the sos service URN to query the RDF. This call flow assumes that the Route URI that is returned by the RDF is the URI associated with a legacy PSAP, and that the call is forwarded via an (egress) IBCF to an i3 LPG with the callback/E.164 number, LbyR, and Additional Data (by-reference) that was provided to the IMS-based NG9-1-1 Emergency Services Network by the LNG.

The call flow depicted in Figure 8-6 assumes that the LPG generates a pANI for the call and, based on per-PSAP provisioning, associates an appropriate Numbering Plan Digit (NPD) or ANI II value with the call (depending on whether the PSAP supports a Traditional MF interface or an Enhanced MF interface).

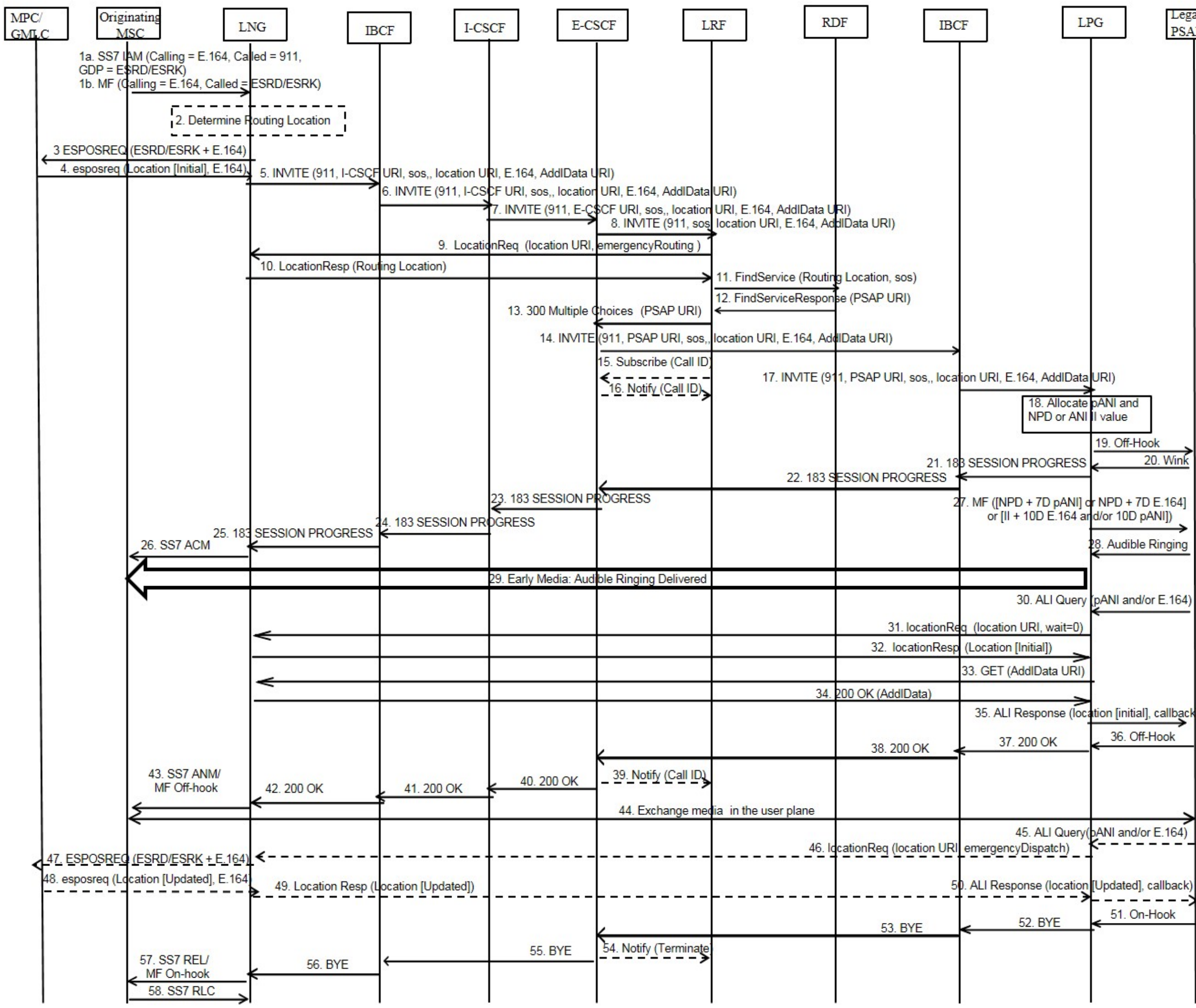

Figure 8-6: Delivery of Legacy Wireless Emergency Call Origination to Legacy PSAP Using NCAS

Step 1. The originating MSC sends an emergency call origination from a legacy wireless caller to the LNG over an MF or SS7-supported trunk group.

(a) If the call is delivered over an SS7 trunk group, the call setup signaling includes the calling (E.164) number sent in the Calling Party Number parameter, the ESRD/ESRK sent in the SS7 GDP, and the digits “911” in the SS7 Called Party Number parameter.

(b) If the call is delivered over an MF trunk group, the call setup signaling includes the ESRD/ESRK signaled as the called number, and the E.164 number signaled as the ANI.

Step 2. The LNG accesses pre-provisioned data that maps the ESRD/ESRK received in incoming signaling from the MSC to a routing location chosen so that it will route to the target PSAP associated with the ESRD/ESRK (i.e., the Associated Location). The LNG uses the routing location to query an i3 ECRF to obtain the Route URI associated with the I-CSCF in the IMS-based NG9-1-1 Emergency Services Network (not shown).

Step 3. The LNG queries an MPC/GMLC in the legacy wireless originating network (using the ESRD/ESRK and the E.164 number received in incoming signaling from the MSC) to obtain initial display location information for the call. In this example, the LNG uses the E2 protocol. Note that Steps 2 and 3 may be performed in parallel, depending on the implementation.

Step 4. The MPC/GMLC responds with the callback number and initial display location, as well as non-location information (e.g., class of service).

Step 5. LNG generates an outgoing SIP INVITE message, populating the E.164 number received from the MSC in the From and PAI headers, “911” (expressed as a URI) in the To header, a service URN of urn:service:sos in the Request-URI, and the I-CSCF URI obtained from the ECRF in the Route header. The outgoing SIP INVITE message also includes a Geolocation header that contains a location reference URI, and a Geolocation-Routing header set to “yes”. The LNG creates an Additional Data structure per NENA-STA-010.2 and passes it forward “by-reference” by including a Call-Info header with a reference URI in the outgoing SIP INVITE message. The LNG forwards this SIP INVITE message to the (ingress) IBCF.

Step 6. The (ingress) IBCF forwards the SIP INVITE message to the I-CSCF.

Step 7. The I-CSCF forwards the SIP INVITE to the pre-configured E-CSCF.

Step 8. The E-CSCF forwards the SIP INVITE to the LRF.

Step 9. Since the SIP INVITE contains a LbyR, the LRF generates a de-reference request to the element identified in the location URI (i.e., the LNG) to obtain the routing location for the call. This example illustrates the use of HELD as the de-referencing protocol, with a responseTime parameter value of “emergencyRouting”.

Step 10. The LNG responds to the de-reference request by returning the routing location obtained in Step 2.

Step 11. The LRF queries the RDF with the routing location received in Step 10 and the emergency service URN (urn:service:sos) received in the SIP INVITE message from the E-CSCF.

Step 12. The RDF returns a Route URI. In this example, the Route URI is associated with a legacy PSAP that is served by the IMS-based NG9-1-1 Emergency Services Network.

Step 13. The LRF redirects the call back to the E-CSCF, passing the Route (PSAP) URI.

Step 14. The E-CSCF generates an outgoing SIP INVITE message, using the information received from the LNG and the LRF, and forwards it to the (egress) IBCF. The SIP INVITE message contains “911” (expressed as a URI) in the To header; the PSAP URI in the Route header; the sos service URN in the Request-URI; the E.164 number in the P-Asserted-Identity and From headers; the LbyR in the Geolocation header, a Geolocation-Routing header set to “yes”, and a pointer (i.e., reference URI) in the Call-Info header to the Additional Data structure created by the LNG.

Step 15. (Optional) The LRF may subscribe to the state of the call.

Step 16. (Conditional on Step 15) The E-CSCF sends an initial notification of the state.

Step 17. The (egress) IBCF forwards the SIP INVITE to the LPG.

Step 18. The LPG determines, based on provisioning, whether the PSAP associated with the received PSAP URI supports a Traditional MF or Enhanced MF interface. Depending on the type of interface supported by the PSAP, the LPG may generate a pANI and will assign an appropriate NPD or ANI II value to the call, following the procedures specified in Section 7.2.2 of NENA-STA-010.2.

Step 19. The LPG generates an off-hook signal toward the legacy PSAP.

Step 20. The legacy PSAP returns a wink signal back to the LPG.

Step 21. The LPG generates a 183 Session Progress message and sends it to the (egress) IBCF.

Step 22. The (egress) IBCF passes the 183 Session Progress message to the E-CSCF.

Step 23. The E-CSCF passes the 183 Session Progress message to the I-CSCF.

Step 24. The I-CSCF passes the 183 Session Progress message to the (ingress) IBCF.

Step 25. The (ingress) IBCF passes the 183 Session Progress message to the LNG.

Step 26. The LNG maps the 183 Session Progress message to an SS7 ACM (assuming that the call was received by the LNG over an SS7-supported trunk group) and passes it to the originating MSC.

Step 27. The LPG delivers the call to the legacy PSAP, mapping the SIP signaling from the incoming INVITE message to the outgoing Traditional or Enhanced MF signaling sequences.

- For PSAPs that support a Traditional MF interface where delivery of callback information is preferred, the LPG will map the information received in the From/P-Asserted-Identity headers of the incoming SIP INVITE message, adding an appropriate NPD digit (i.e., the NPD + 7D E.164 number), to the MF ANI sequence KP + NPD + NXX XXXX + ST.
- For PSAPs that support a Traditional MF interface where delivery of location information is preferred, the LPG will populate the pANI it generated, along with an appropriate NPD digit (i.e., the NPD + 7D pANI) in the MF ANI sequence KP + NPD + NXX XXXX + ST.
- For PSAPs that support an Enhanced MF interface with 10-digit delivery where delivery of callback information is preferred, the LPG will map the information received in the P-Asserted-Identity header of the SIP INVITE message along with an appropriate II value (i.e., the II digits plus the 10D E.164 number) to the MF ANI sequence KP + II + NPA NXX XXXX + ST´.
- For PSAPs that support an Enhanced MF interface with 10-digit delivery where delivery of location information is preferred, the LPG will populate the pANI it generated along with an appropriate II value (i.e., the II digits plus the 10D pANI) in the MF ANI sequence KP + II + NPA NXX XXXX + ST´.
- For PSAPs that support an Enhanced MF interface with 20-digit delivery, the LPG will populate the pANI that it generated and the information received in the PAI (i.e., the E.164 number) along with an appropriate II value in the MF sequence KP + II + NPA NXX XXXX + ST + KP + NPA NXX XXXX + ST, where the first 10-digit number is mapped from the PAI and the second 10-digit number contain the pANI.

Step 28. Audible ringing is returned by the legacy PSAP to the LPG.

Step 29. Audible ringing is passed to the originating MSC/caller.

Step 30. The legacy PSAP sends a location query to the LPG using a NENA-defined ALI query protocol. The ALI query includes the 10-digit pANI and/or 10-digit E.164 number received in Step 27. (Note that this can happen any time after Step 27.)

Step 31. Since, in this example, LbyR was delivered to the LPG in the SIP INVITE message, the LPG sends a de-reference request to the LNG (as identified in the location URI) for initial display location (i.e., responseTime contains a wait timer value of "0").

Step 32. The LNG returns the initial display location from Step 4 to the LPG in the de-reference response.

Step 33. In this example, the SIP INVITE received by the LPG contains an Additional Data URI, so the LPG queries the LNG (as identified in the URI) for Additional Data using an HTTPS GET operation.

Step 34. The LNG provides the requested Additional Data in a 200 OK response.[17]

[17] Note that Steps 31 through 34 can happen any time after Step 27, and that Steps 31 and 32 can be performed either before or after Steps 33 and 34.

Step 35. The LPG returns an ALI response to the legacy PSAP that includes initial display location information, a callback number and other information (e.g., class of service), as appropriate for the interface.

Step 36. When the PSAP answers the call, it returns an off-hook signal to the LPG.

Step 37. In response to the off-hook signal, the LPG generates a SIP 200 OK message and passes it to the (egress) IBCF.

Step 38. The (egress) IBCF passes the SIP 200 OK message to the E-CSCF.

Step 39. The E-CSCF sends a notification to the LRF updating the call state.

Step 40. The E-CSCF passes the SIP 200 OK message to the I-CSCF.

Step 41. The I-CSCF passes the SIP 200 OK message to the (ingress) IBCF.

Step 42. The (ingress) IBCF passes the SIP 200 OK message to the LNG.

Step 43. The LNG maps the SIP 200 OK message to an SS7 ANM message or MF off-hook signal to the originating MSC.

Step 44. At this point a two-way connection is established between the caller and the PSAP.

Step 45. (Optional) The PSAP queries the LPG for updated (dispatch) location information.

Step 46. (Conditional on Step 45) The LPG sends a de-reference request to the LNG (as identified in the location URI) for updated (dispatch) location information (responseTime parameter = “emergencyDispatch” in this example).

Step 47. (Conditional on Step 46) The LNG queries the MPC/GMLC for updated (dispatch) location. (Note that the value of the responseTime parameter [emergencyDispatch or a specific time value] will be used by the LNG to determine whether to query the MPC/GMLC.)

Step 48. (Conditional on Step 47) The MPC/GMLC returns updated (dispatch) location information to the LNG.

Step 49. (Conditional on Step 46) The LNG returns the updated (dispatch) location from Step 48 to the LPG in the de-reference response.

Step 50. (Conditional on Step 45) The LPG supplies updated (dispatch) location to the PSAP for display at the PSAP.

Step 51. At some point the call is terminated. In this call flow, the PSAP terminates the call and sends an on-hook indication to the LPG.

Step 52. The LPG maps the on-hook indication to a SIP BYE message and sends the SIP BYE message to the (egress) IBCF.

Step 53. The (egress) IBCF passes the SIP BYE message to the E-CSCF.

Step 54. The E-CSCF then notifies the LRF that the call has terminated.

Step 55. The E-CSCF passes the SIP BYE message to the (ingress) IBCF.

Step 56. The (ingress) IBCF passes the SIP BYE message to the LNG.

Step 57. The LNG maps the SIP BYE message to an SS7 REL message or an MF on-hook indication, as appropriate, and sends it to the originating MSC.

Step 58. Upon receiving an SS7 REL message, the originating MSC sends an SS7 RLC message to the LNG.

8.3 IMS Originating Network to i3 and Legacy PSAPs – LbyV

8.3.1 Delivery of Emergency Call Origination from IMS Origination Network to i3 PSAP with LbyV

The call flow provided in Figure 8-7 illustrates a scenario where an emergency call is delivered by an IMS origination network to an IMS-based NG9-1-1 Emergency Services Network with LbyV. The call is delivered to an IBCF on the ingress side of the IMS-based NG9-1-1 Emergency Services Network. The SIP INVITE message signaled by the IMS originating network includes a Route header that contains the URI of an I-CSCF in the IMS-based NG9-1-1 Emergency Services Network, an emergency services service URN (urn:service:sos) in the Request-URI, callback information in the P-Asserted-Identity header, and LbyV and Additional Data "by value" in the message body. (A Geolocation header that contains a Content-ID (cid) pointing to the PIDF-LO in the message body, a Geolocation-Routing header set to "yes", a Call-Info header that contains a cid pointing to the Additional Data in the message body, and other SIP headers will also be included in the SIP INVITE message, but are not specifically illustrated in Figure 8-7.) This call flow assumes that the I-CSCF forwards the SIP INVITE message to the E-CSCF. The E-CSCF forwards the SIP INVITE message to the LRF. The LRF uses the LbyV to query the RDF. In this example call flow, the Route URI that is returned by the RDF is associated with an i3 PSAP. This call flow assumes that the call is delivered to the i3 PSAP with LbyV and Additional Data "by value".

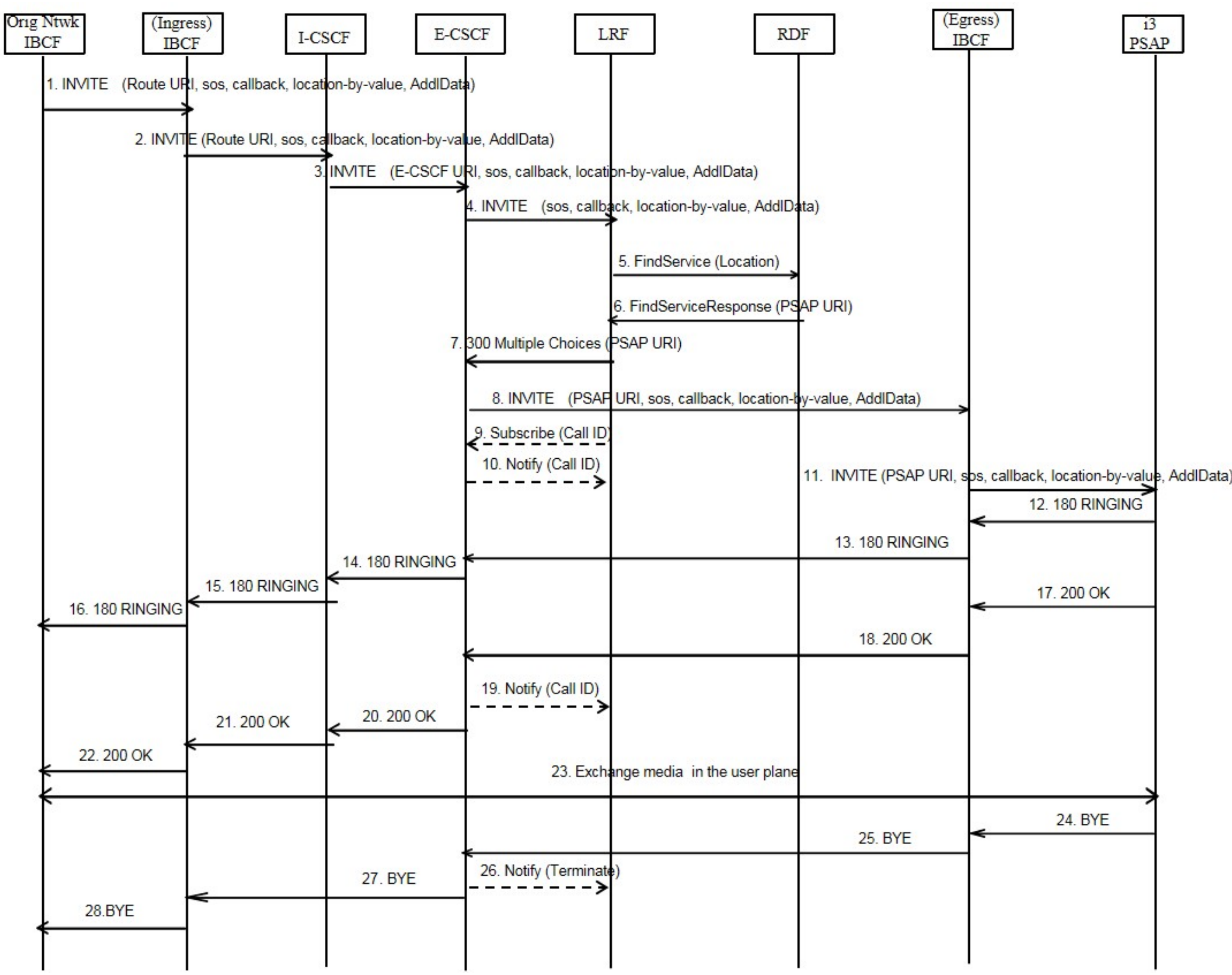

Figure 8-7: Delivery of IMS Emergency Call Origination to i3 PSAP with LbyV

Step 1. The IBCF in the IMS 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 i3 PSAP that is served by the IMS-based NG9-1-1 Emergency Services Network.

Step 7. The LRF redirects the call back to the E-CSCF, passing the Route (PSAP) URI.

Step 8. The E-CSCF generates an outgoing SIP INVITE message, using the information received from the LRF as well as information received in the initial SIP INVITE message, and forwards it to the (egress) IBCF. The SIP INVITE message contains the PSAP URI 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. (Optional) The LRF may subscribe to the state of the call.

Step 10. (Conditional on Step 9) The E-CSCF sends an initial notification of the call state.

Step 11. The (egress) IBCF forwards the SIP INVITE to the i3 PSAP with the callback information, the LbyV, and the Additional Data received in the initial SIP INVITE message from the IMS originating network.

Step 12. An indication that the call taker is being alerted is returned by the i3 PSAP to the (egress) IBCF (using a SIP 180 RINGING message).

Step 13. The (egress) IBCF passes the SIP 180 RINGING message to the E-CSCF.

Step 14. The E-CSCF passes the SIP 180 RINGING message to the I-CSCF.

Step 15. The I-CSCF passes the SIP 180 RINGING message to the (ingress) IBCF.

Step 16. The (ingress) IBCF passes the SIP 180 RINGING message to the originating network via the originating network IBCF.

Step 17. When the PSAP answers the call, it returns a SIP 200 OK message to the (egress) IBCF.

Step 18. The (egress) IBCF passes the SIP 200 OK message to the E-CSCF.

Step 19. (Conditional on Step 9) The E-CSCF sends a notification to the LRF updating the call state.

Step 20. The E-CSCF passes the SIP 200 OK message to the I-CSCF.

Step 21. The I-CSCF passes the SIP 200 OK message to the (ingress) IBCF.

Step 22. The (ingress) IBCF passes the SIP 200 OK message to the originating network via the originating network IBCF.

Step 23. At this point a two-way connection is established between the caller and the PSAP.

Step 24. At some point the call is terminated. In this call flow, the PSAP terminates the call and sends a SIP BYE message to the (egress) IBCF.

Step 25. The SIP BYE is passed from the (egress) IBCF to the E-CSCF.

Step 26. (Conditional on Step 9) The E-CSCF then notifies the LRF that the call has terminated.

Step 27. The E-CSCF passes the SIP BYE message to the (ingress) IBCF.

Step 28. The (ingress) IBCF passes the SIP BYE message to the originating network via the originating network IBCF.

8.3.2 Delivery of Emergency Call Origination from IMS Origination Network to Legacy PSAP with LbyV

The call flow provided in Figure 8-8 illustrates a scenario where an emergency call is delivered by an IMS origination network to an IMS-based NG9-1-1 Emergency Services Network with LbyV. The call is delivered to an IBCF on the ingress side of the IMS-based NG9-1-1 Emergency Services Network. The SIP INVITE message signaled by the IMS originating network includes a Route header that contains the URI of an I-CSCF in the IMS-based NG9-1-1 Emergency Services Network, an emergency services service URN (urn:service:sos) in the Request-URI, callback information in the P-Asserted-Identity header, and LbyV and Additional Data (by value) in the message body. (A Geolocation header that contains a cid pointing to the PIDF-LO in the message body, a Geolocation-Routing header set to “yes”, a Call-Info header that contains a cid pointing to the Additional Data in the message body, and other SIP headers will also be included in the SIP INVITE message, but are not specifically illustrated in Figure 8-8.) This call flow assumes that the I-CSCF forwards the SIP INVITE message to the E-CSCF. The E-CSCF forwards the SIP INVITE message to the LRF. The LRF uses the LbyV to query the RDF. In this example call flow, the Route URI that is returned by the RDF is associated with a legacy PSAP, and the call is forwarded via an (egress) IBCF to an i3 LPG with the LbyV and Additional Data (by value) that was provided to the IMS-based NG9-1-1 Emergency Services Network by the IMS originating network. The call flow depicted in Figure 8-8 assumes that the LPG generates a 7/10-digit pANI for the call and, based on per-PSAP provisioning, associates an appropriate Numbering Plan Digit (NPD) or ANI II value with the call (depending on whether the PSAP supports a Traditional MF interface or an Enhanced MF interface).

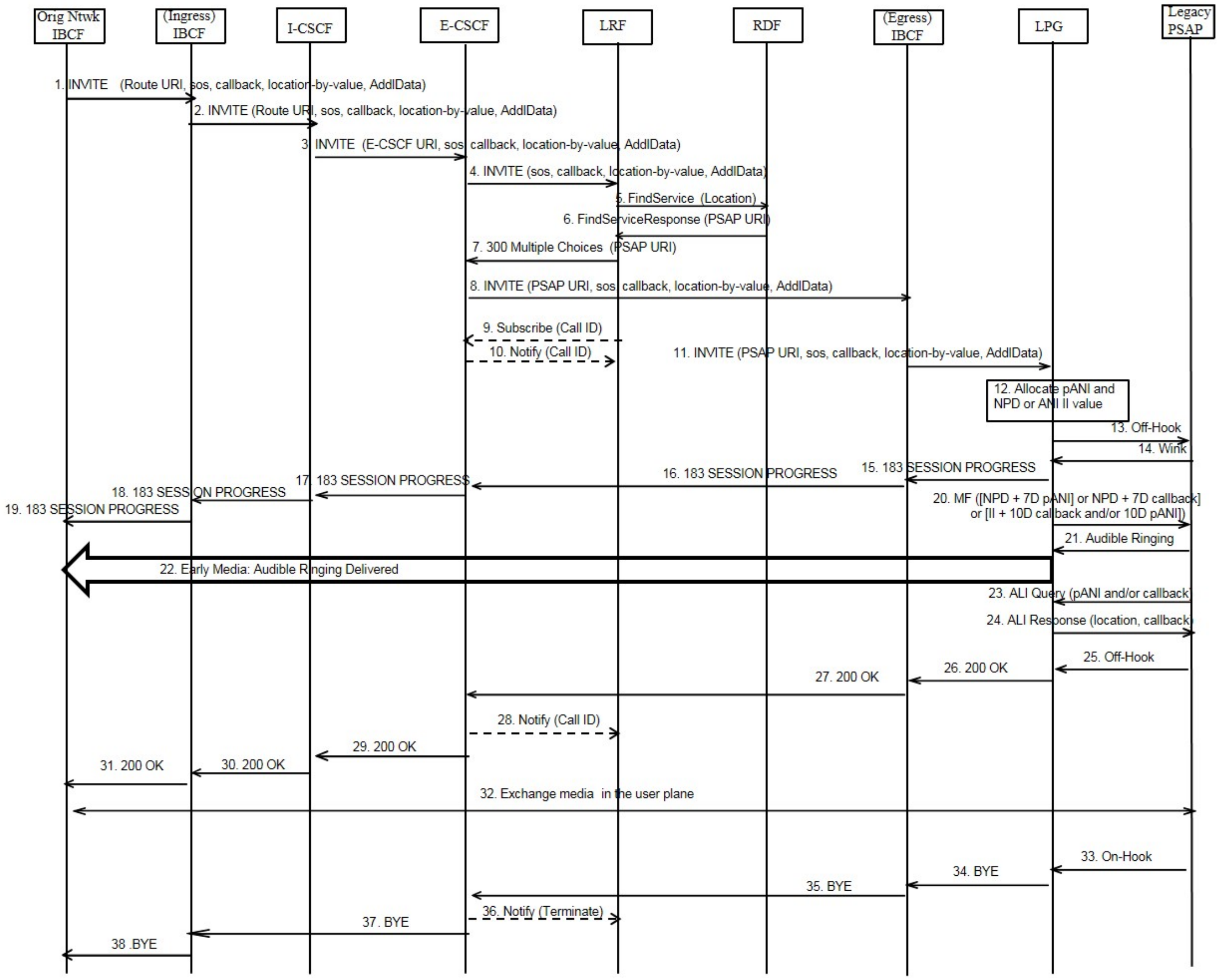

Figure 8-8: Delivery of IMS Emergency Call Origination to Legacy PSAP with LbyV

Step 1. The IBCF in the IMS 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 a legacy PSAP that is served by the IMS-based NG9-1-1 Emergency Services Network.

Step 7. The LRF redirects the call back to the E-CSCF, passing the Route (PSAP) URI.

Step 8. The E-CSCF generates an outgoing SIP INVITE message, using the information received from the LRF, as well as information received in the initial SIP INVITE message, and forwards it to the (egress) IBCF. The SIP INVITE message includes the PSAP URI in the Route header; the sos service URN in the Request-URI; the callback number in the P-Asserted-Identity and From headers; a cid in the Geolocation header; a Geolocation-Routing header set to “yes”; a cid in the Call-Info header; and LbyV and Additional Data (by value) in the message body.

Step 9. (Optional) The LRF may subscribe to the state of the call.

Step 10. (Conditional on Step 9) The E-CSCF sends an initial notification of the call state.

Step 11. The (egress) IBCF forwards the SIP INVITE to the LPG.

Step 12. The LPG determines, based on provisioning, whether the PSAP associated with the received PSAP URI supports a Traditional MF or Enhanced MF interface. Depending on the type of interface supported by the PSAP, the LPG may generate a pANI[18] and will assign an appropriate NPD or ANI II value to the call, following the procedures specified in Section 7.2.2 of NENA-STA-010.2 [Ref 27].

Step 13. The LPG generates an off-hook signal toward the legacy PSAP.

Step 14. The legacy PSAP returns a wink signal back to the LPG.

Step 15. The LPG generates a 183 Session Progress message and sends it to the (egress) IBCF.

Step 16. The (egress) IBCF passes the 183 Session Progress message to the E-CSCF.

Step 17. The E-CSCF passes the 183 Session Progress message to the I-CSCF.

Step 18. The I-CSCF passes the 183 Session Progress message to the (ingress) IBCF.

Step 19. The (ingress) IBCF passes the SIP 183 Session Progress message to the originating network via the originating network IBCF.

Step 20. The LPG maps the SIP signaling from the incoming INVITE message to the outgoing Traditional or Enhanced MF signaling sequences and forwards the call to the legacy PSAP.

- For PSAPs that support a Traditional MF interface where delivery of callback information is preferred, the LPG will map the information received in the From/P-Asserted-Identity headers of the incoming SIP INVITE message, if that information is in the form of (or easily converted to) a 10-digit NANP number. If the callback information is not in the form of (or easily converted to) a 10-digit NANP number, the LPG will generate a pANI, following the procedures in Section 7.2.2 of NENA-STA-010.2. The LPG will also allocate an appropriate NPD digit based on the NPA associated with the callback information/pANI. The LPG will then signal the NPD and 7-digit callback number or pANI in the MF ANI sequence KP + NPD + NXX XXXX + ST.
- For PSAPs that support a Traditional MF interface where delivery of location information is preferred, the LPG will generate a pANI and populate it, along with an appropriate NPD digit (i.e., the NPD + 7D pANI), in the MF ANI sequence KP + NPD + NXX XXXX + ST.
- For PSAPs that support an Enhanced MF interface with 10-digit delivery where delivery of callback information is preferred, the LPG will map the information received in the From/P-Asserted-Identity headers of the SIP INVITE message, if that information is in the form of (or easily converted to) a 10-digit NANP number. If the callback information is not in the form of (or easily converted to) a 10-digit NANP number, the LPG will generate a pANI, following the procedures in Section 7.2.2 of NENA-STA-010.2. The LPG will allocate an appropriate II value and then signal the II digits plus the 10D pANI or 10D callback number to the PSAP in the MF ANI sequence KP + II + NPA NXX XXXX + ST´.

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[18] If the PSAP expects delivery of a location key, or it expects the delivery of a callback number and the callback information received by the LPG in the SIP INVITE message is not in the form of, or easily converted to, a 10-digit NANP number, the LPG will generate a pANI.

- For PSAPs that support an Enhanced MF interface with 10-digit delivery where delivery of location information is preferred, the LPG will generate a pANI and populate it, along with an appropriate II value (i.e., the II digits plus the 10D pANI), in the MF ANI sequence KP + II + NPA NXX XXXX + ST´.
- For PSAPs that support an Enhanced MF interface with 20-digit delivery, the LPG will map the pANI (representing the LbyV) that it generated and the callback information that it received in the From/PAI headers (or a pANI if the callback information is not in the form of, or easily converted to, a 10-digit NANP number), along with an II value allocated by the LPG, to the MF sequence KP + II + NPA NXX XXXX + ST + KP + NPA NXX XXXX + ST, where the first 10-digit number is associated with the callback information from the PAI/From headers and the second 10-digit number contains the pANI associated with the LbyV.[19]

Step 21. Audible ringing is returned by the legacy PSAP to the LPG.

Step 22. Audible ringing is passed to the originating network/caller.

Step 23. The legacy PSAP sends a location query to the LPG using a legacy ALI protocol. The ALI query includes the 10-digit pANI and/or callback number received in Step 20. (Note that this can happen any time after Step 20.)

Step 24. The LPG returns an ALI response to the legacy PSAP that includes location information, a callback number and other information (e.g., class of service), as appropriate for the interface.

Step 25. When the PSAP answers the call, it returns an off-hook signal to the LPG.

Step 26. In response to the off-hook signal, the LPG generates a SIP 200 OK message and passes it to the (egress) IBCF.

Step 27. The (egress) IBCF passes the SIP 200 OK message to the E-CSCF.

Step 28. (Conditional on Step 9) The E-CSCF sends a notification to the LRF updating the call state.

Step 29. The E-CSCF passes the SIP 200 OK message to the I-CSCF.

Step 30. The I-CSCF passes the SIP 200 OK message to the (ingress) IBCF.

Step 31. The (ingress) IBCF passes the SIP 200 OK message to the originating network via the originating network IBCF.

Step 32. At this point a two-way connection is established between the caller and the PSAP.

Step 33. At some point the call is terminated. In this call flow, the PSAP terminates the call and sends an on-hook indication to the LPG.

Step 34. The LPG maps the on-hook indication to a SIP BYE message and sends the SIP BYE message to the (egress) IBCF.

Step 35. The (egress) IBCF passes the SIP BYE message to the E-CSCF.

Step 36. (Conditional on Step 9) The E-CSCF then notifies the LRF that the call has terminated.

Step 37. The E-CSCF passes the SIP BYE message to the (ingress) IBCF.

Step 38. The (ingress) IBCF passes the SIP BYE message to the originating network via the originating network IBCF.

[19] Note that the same pANI value can be used to represent the location and the callback information.

8.4 IMS Originating Network to i3 and Legacy PSAPs – LbyR

8.4.1 Delivery of Emergency Call Origination from IMS Origination Network to i3 PSAP with LbyR

The call flow provided in Figure 8-9 illustrates a scenario where an emergency call is delivered by an IMS origination network to an IMS-based NG9-1-1 Emergency Services Network with LbyR and Additional Data (by reference). The call is delivered to an IBCF on the ingress side of the IMS-based NG9-1-1 Emergency Services Network. The SIP INVITE message signaled by the IMS originating network includes a Route header that contains the URI of an I-CSCF in the IMS-based NG9-1-1 Emergency Services Network, an emergency services service URN (urn:service:sos) in the Request-URI, callback information in the P-Asserted-Identity header, a LbyR URI in the Geolocation header, and an Additional Data URI in the Call-info header. (A Geolocation-Routing header set to "yes", and other SIP headers will also be included in the SIP INVITE message, but are not specifically illustrated in Figure 8-9.) In this example call flow, the I-CSCF forwards the SIP INVITE message to the E-CSCF which passes it to the LRF. The LRF de-references the received LbyR URI by sending a de-reference request to the LRF in the originating IMS network. The LRF then uses the LbyV received in the de-reference response to query the RDF. In this example flow, the Route URI that is returned by the RDF is assumed to be associated with an i3 PSAP. Figure 8-9 shows the emergency call then being delivered to the i3 PSAP with the same LbyR and Additional Data (by reference) as was received by the IMS-based NG9-1-1 Emergency Services Network in incoming signaling from the originating IMS network.

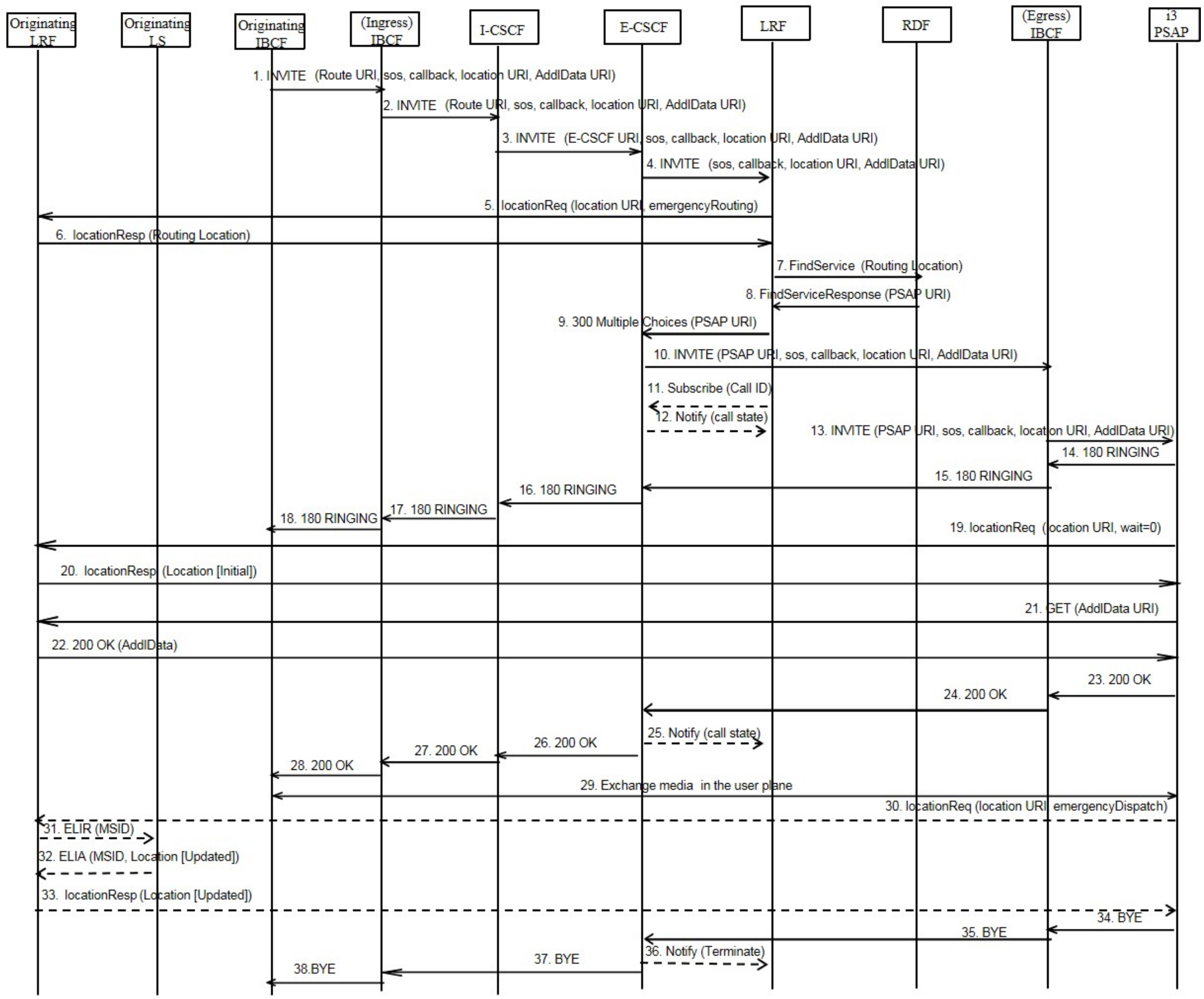

Figure 8-9: Delivery of IMS Emergency Call Origination to i3 PSAP with LbyR

Step 1. The IBCF in the IMS 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, a LbyR URI, and an Additional Data URI.

Step 2. The 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, LbyR URI, and Additional Data URI, as received in the incoming SIP INVITE message.

Step 4. The E-CSCF forwards the SIP INVITE to the LRF.

Step 5. In this example, the SIP INVITE contains a LbyR URI, so the LRF in the IMS-based NG9-1-1 Emergency Services Network queries the LRF in the IMS originating network (as identified in the LbyR URI) for the routing location (i.e., responseTime parameter = emergencyRouting).

Step 6. The originating LRF returns the Routing Location that is associated with the LbyR URI.

Step 7. The LRF queries the RDF using the location information obtained in Step 6 and the emergency service URN (urn:service:sos).

Step 8. The RDF returns a Route URI. In this example, the Route URI is associated with an i3 PSAP that is served by the IMS-based NG9-1-1 Emergency Services Network.

Step 9. The LRF redirects the call back to the E-CSCF, passing the Route (PSAP) URI.

Step 10. 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 PSAP URI in the Route header, the sos service URN in the Request-URI, the callback information in the From and P-Asserted-Identity headers, the LbyR URI in the Geolocation header, and an Additional Data URI in the Call-Info header. (A Geolocation-Routing header set to “yes” will also be present in the SIP INVITE message, as well as other SIP headers per RFC 3261 [Ref 18]).

Step 11. (Optional) The LRF may subscribe to the state of the call.

Step 12. (Conditional on Step 11) The E-CSCF sends an initial notification of the call state.

Step 13. The (egress) IBCF forwards the SIP INVITE message to the i3 PSAP with the callback information, LbyR URI, and Additional Data URI received by the IMS-based NG9-1-1 Emergency Services Network in the SIP INVITE message from the IMS originating network.

Step 14. An indication that the call taker is being alerted is returned by the i3 PSAP to the (egress) IBCF (using a SIP 180 RINGING message).

Step 15. The (egress) IBCF passes the SIP 180 RINGING message to the E-CSCF.

Step 16. The E-CSCF passes the SIP 180 RINGING message to the I-CSCF.

Step 17. The I-CSCF passes the SIP 180 RINGING message to the (ingress) IBCF.

Step 18. The (ingress) IBCF passes the SIP 180 RINGING message to the originating network via the originating network IBCF.

Step 19. Since the SIP INVITE message received by the i3 PSAP contains a LbyR, the i3 PSAP queries the LRF in the originating IMS network (as identified in the LbyR URI) for initial dispatch location (i.e., responseTime contains a wait timer value of “0”). (Note that this can occur any time after Step13.)

Step 20. The originating LRF supplies the initial dispatch location information to the PSAP. The initial display location information is displayed at the PSAP CPE.

Step 21. Since the SIP INVITE message received by the i3 PSAP contains Additional Data (by reference), the i3 PSAP queries the LRF in the originating IMS network using a GET request. (Note that this can occur any time after Step 13.)

Step 22. The originating LRF supplies the Additional Data (by value) to the PSAP.

Step 23. When the PSAP answers the call, it returns a SIP 200 OK message to the (egress) IBCF.

Step 24. The (egress) IBCF passes the SIP 200 OK message to the E-CSCF.

Step 25. (Conditional on Step 11) The E-CSCF sends a notification to the LRF updating the call state.

Step 26. The E-CSCF passes the SIP 200 OK message to the I-CSCF.

Step 27. The I-CSCF passes the SIP 200 OK message to the (ingress) IBCF.

Step 28. The (ingress) IBCF passes the SIP 200 OK message to the originating network via the originating network IBCF.

Step 29. At this point a two-way connection is established between the caller and the PSAP.

Step 30. (Optional) The PSAP queries the LRF in the originating IMS network (as identified in the LbyR URI) for updated (dispatch) location information (responseTime parameter = “emergencyDispatch” in this example).

Step 31. (Conditional on Step 30) The originating LRF queries the LS for updated (dispatch) location. (Note that the value of the responseTime parameter [emergencyDispatch or a specific time value] will be used by the LRF to determine whether to query the LS.)

Step 32. (Conditional on Step 31) The LS returns updated (dispatch) location information to the originating LRF.

Step 33. (Conditional on Step 30) The LRF in the IMS-based originating network supplies the updated (dispatch) location to the i3 PSAP and it is displayed on the PSAP CPE.

Step 34. At some point the call is terminated. In this call flow, the PSAP terminates the call and sends a SIP BYE message to the (egress) IBCF.

Step 35. The SIP BYE is passed from the (egress) IBCF to the E-CSCF.

Step 36. (Conditional on Step 11) The E-CSCF then notifies the LRF that the call has terminated.

Step 37. The E-CSCF passes the SIP BYE message to the (ingress) IBCF.

Step 38. The (ingress) IBCF passes the SIP BYE message to the originating network via the originating network IBCF.

8.4.2 Delivery of Emergency Call Origination from IMS Origination Network to Legacy PSAP with LbyR

The call flow provided in Figure 8-10 illustrates a scenario where an emergency call is delivered by an IMS origination network to an IMS-based NG9-1-1 Emergency Services Network with LbyR and Additional Data (by reference). The call is delivered to an IBCF on the ingress side of the IMS-based NG9-1-1 Emergency Services Network. The SIP INVITE message signaled by the IMS originating network includes a Route header that contains the URI of an I-CSCF in the IMS-based NG9-1-1 Emergency Services Network, an emergency services service URN (urn:service:sos) in the Request-URI, callback information in the P-Asserted-Identity header, a LbyR URI in the Geolocation header, and an Additional Data URI in the Call-info header. (A Geolocation-Routing header set to “yes”, and other SIP headers will also be included in the SIP INVITE message, per RFC 3261 [Ref 18]. These headers are not specifically illustrated in Figure 8-10.) This call flow assumes that the I-CSCF forwards the SIP INVITE message to the E-CSCF, and the E-CSCF forwards it to the LRF. The LRF de-references the received LbyR URI by sending a de-reference request to the LRF in the originating IMS network. The LRF then uses the LbyV received in the de-reference response to query the RDF. In this example call flow, the Route URI that is returned by the RDF is associated with a legacy PSAP. The call flow depicted in Figure 8-10 assumes that the LPG may generate a 7/10-digit pANI for the call and, based on per-PSAP provisioning, associates an appropriate Numbering Plan Digit (NPD) or ANI II value with the call (depending on whether the PSAP supports a Traditional MF interface or an Enhanced MF interface).

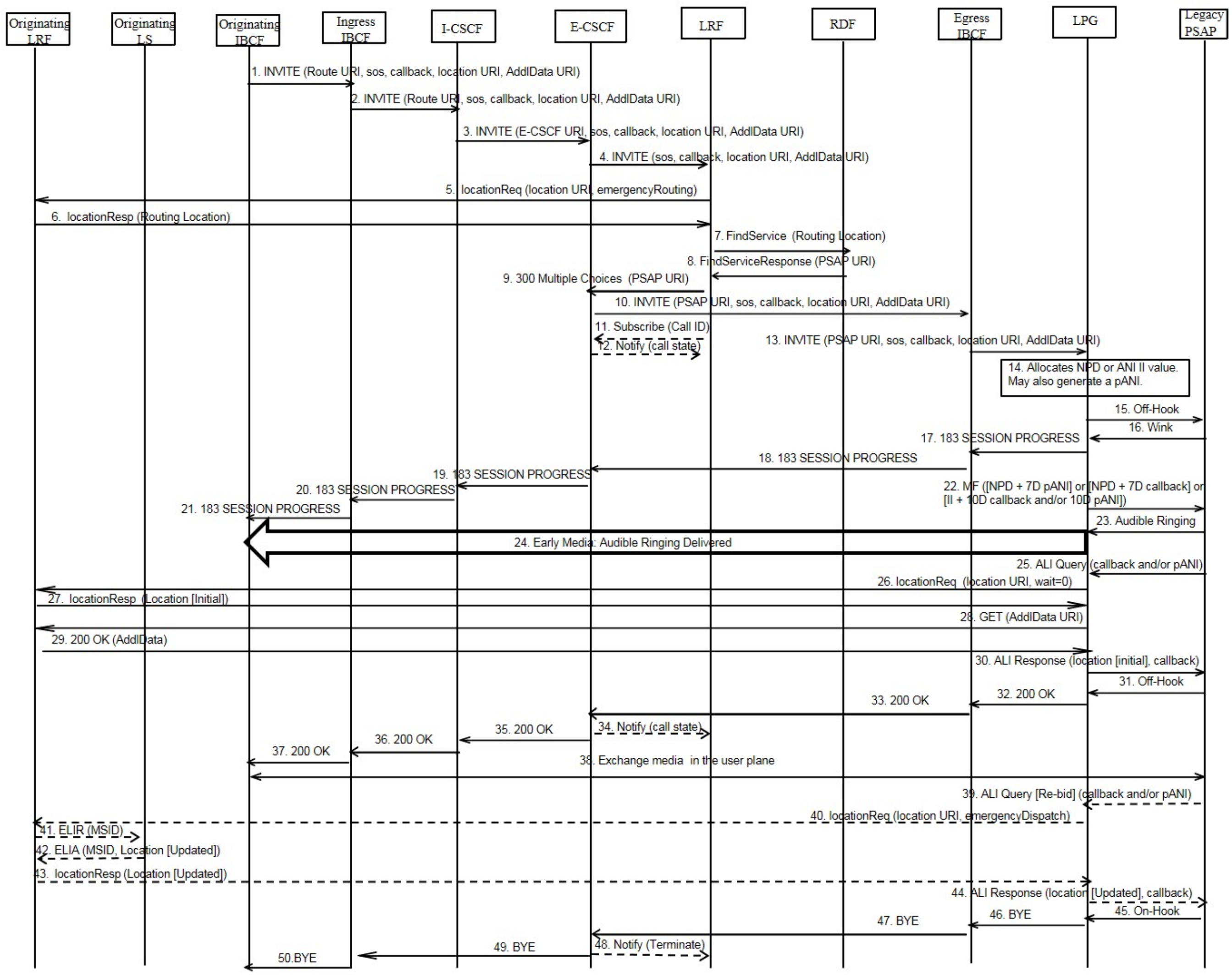

Figure 8-10: Delivery of IMS Emergency Call Origination to Legacy PSAP with LbyR

Step 1. The IBCF in the IMS 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, a LbyR URI, and an Additional Data URI.

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, LbyR, and an Additional Data URI, as received in the incoming SIP INVITE message.

Step 4. The E-CSCF forwards the SIP INVITE to the LRF.

Step 5. In this example, the SIP INVITE contains a LbyR URI, so the LRF in the IMS-based NG9-1-1 Emergency Services Network queries the LRF in the IMS originating network (as identified in the location URI) for routing location (i.e., responseTime parameter = emergencyRouting).

Step 6. The originating LRF returns the Routing Location that is associated with the LbyR URI.

Step 7. The LRF queries the RDF using the location information obtained in Step 6 and the emergency service URN (urn:service:sos).

Step 8. The RDF returns a Route URI. In this example, the Route URI is associated with a legacy PSAP that is served by the IMS-based NG9-1-1 Emergency Services Network.

Step 9. The LRF redirects the call back to the E-CSCF, passing the Route (PSAP) URI.

Step 10. 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 includes the PSAP URI in the Route header, the sos service URN in the Request-URI, the callback information in the From and P-Asserted-Identity headers, the LbyR URI in the Geolocation header, and an Additional Data URI in the Call-Info header. (A Geolocation-Routing header set to "yes" will also be present in the SIP INVITE message, as well as other SIP headers per RFC 3261 [Ref 18]).

Step 11. (Optional) The LRF may subscribe to the state of the call.

Step 12. (Conditional on Step 11) The E-CSCF sends an initial notification of the state.

Step 13. The (egress) IBCF forwards the SIP INVITE to the LPG.

Step 14. The LPG determines, based on provisioning, whether the PSAP associated with the received PSAP URI supports a Traditional MF or Enhanced MF interface. Depending on the type of interface supported by the PSAP, the LPG may generate a pANI and will assign an appropriate NPD or ANI II value to the call, following the procedures specified in Section 7.2.2 of NENA-STA-010.2 [Ref 27].

Step 15. The LPG generates an off-hook signal toward the legacy PSAP.

Step 16. The legacy PSAP returns a wink signal back to the LPG.

Step 17. The LPG generates a 183 Session Progress message and sends it to the (egress) IBCF.

Step 18. The (egress) IBCF passes the 183 Session Progress message to the E-CSCF.

Step 19. The E-CSCF passes the 183 Session Progress message to the I-CSCF.

Step 20. The I-CSCF passes the 183 Session Progress message to the (ingress) IBCF.

Step 21. The (ingress) IBCF passes the SIP 183 Session Progress message to the originating network via the originating network IBCF.

Step 22. The LPG delivers the call to the legacy PSAP, mapping the SIP signaling from the incoming INVITE message to the outgoing Traditional or Enhanced MF signaling sequences.

- If the PSAP supports a Traditional MF interface and is provisioned to receive callback information, and the callback information received in the From/P-Asserted-Identity header is in the form of (or easily converted to) a NANP number with an NPA that is appropriate for the PSAP, the LPG will map the information received in the From/P-Asserted-Identity header of the incoming SIP INVITE message, and the NPD digit it derived in Step 14 (i.e., NPD + 7-digit callback information) to the MF ANI sequence KP + NPD + NXX XXXX + ST.
- If the PSAP supports a Traditional MF interface and is provisioned to receive callback information, and the callback information received by the LPG is not in the form of (or easily converted to) a NANP number with an NPA that is appropriate for the PSAP, the LPG will populate the pANI that it generated and the NPD digit that it derived in Step 14 (i.e., NPD + 7-digit pANI) in the MF ANI sequence KP + NPD + NXX XXXX + ST.
- If the PSAP supports a Traditional MF interface and is provisioned to receive location information, the LPG will populate the pANI that it generated and the NPD digit that it derived in Step 14 (i.e., NPD + 7-digit pANI) in the MF ANI sequence KP + NPD + NXX XXXX + ST.
- If the PSAP supports an Enhanced MF interface with 10-digit delivery, and is provisioned to receive callback information, and the callback information received by the LPG is in the form of (or easily converted to) a NANP number with an NPA that is appropriate for the

PSAP, the LPG will map the information received in the From/P-Asserted-Identity header of the SIP INVITE message, and the II digits it derived in Step 14 (i.e., II + 10-digit callback information) to the MF ANI sequence KP + II + NPA NXX XXXX + ST´.

- If the PSAP supports an Enhanced MF interface with 10-digit delivery, and is provisioned to receive callback information, and the callback information received by the LRF is not in the form of (or easily converted to) a NANP number with an NPA that is appropriate for the PSAP, the LPG will populate the pANI that it generated and the II digits that it derived in Step 14 (i.e., II + 10-digit pANI) in the MF ANI sequence KP + II + NPA NXX XXXX + ST´.
- If the PSAP supports an Enhanced MF interface with 10-digit delivery, and is provisioned to receive location information, the LPG will populate the pANI that it generated and the II digits that it derived in Step 14 (i.e., II + 10-digit pANI) in the MF ANI sequence KP + II + NPA NXX XXXX + ST´.
- For PSAPs that support an Enhanced MF interface with 20-digit delivery, where the callback information received by the LPG is in the form of (or easily converted to) a NANP number with an NPA that is appropriate for the PSAP, the LPG will map the information received in the From/P-Asserted-Identity header along with the II digits that it derived in Step 14 (i.e., II + 10-digit callback information), as well as the pANI that it generated in Step 14 to the MF sequence KP + II + NPA NXX XXXX + ST + KP + NPA NXX XXXX + ST, where the first 10-digit number is mapped from the From/P-Asserted-Identity header and the second 10-digit number contains the pANI generated in Step 14.
- For PSAPs that support an Enhanced MF interface with 20-digit delivery, where the callback information received by the LPG is not in the form of (or easily converted to) a NANP number with an NPA that is appropriate for the PSAP, the LPG will populate the pANI and the II digits that it derived in Step 14 (i.e., II + 10-digit pANI), as well as the pANI that it generated in Step 14 associated with the location information, to the MF sequence KP + II + NPA NXX XXXX + ST + KP + NPA NXX XXXX + ST, where the first 10-digit number is the pANI associated with the callback information and the second 10-digit number is pANI associated with the location information.

  NOTE: The same pANI value can be used to represent both callback information and location information, as specified in NENA-STA-010.2.

Step 23. Audible ringing is returned by the legacy PSAP to the LPG.

Step 24. Audible ringing is passed to the originating network/caller.

Step 25. The legacy PSAP sends a location query to the LPG using a legacy ALI protocol. The ALI query includes the 10-digit callback information and/or pANI received in Step 22. (Note that this can happen any time after Step 22.)

Step 26. The LPG sends a de-reference request to the originating LRF (as identified in the LbyR URI associated with the Reference Identifier/callback information) for initial dispatch location (i.e., responseTime contains a wait timer value of “0”).

Step 27. The originating LRF supplies the initial dispatch location information to the LPG in the de-reference response.

Step 28. In this example, the SIP INVITE received by the LPG contains an Additional Data URI, so the LPG queries the originating LRF (as identified in the URI) for Additional Data using an HTTPS GET operation.

Step 29. The originating LRF provides the requested Additional Data in a 200 OK response.[20]

[20] Note that Steps 26 through 29 can happen any time after Step 22, and that Steps 26 and 27 can be performed either before or after Steps 28 and 29.

Step 30. The LPG returns an ALI response to the legacy PSAP that includes the initial dispatch location information, a callback number and other information (e.g., class of service), as appropriate for the interface.

Step 31. When the PSAP answers the call, it returns an off-hook signal to the LPG.

Step 32. In response to the off-hook signal, the LPG generates a SIP 200 OK message and passes it to the (egress) IBCF.

Step 33. The (egress) IBCF passes the SIP 200 OK message to the E-CSCF.

Step 34. (Conditional on Step 11) The E-CSCF sends a notification to the LRF updating the call state.

Step 35. The E-CSCF passes the SIP 200 OK message to the I-CSCF.

Step 36. The I-CSCF passes the SIP 200 OK message to the (ingress) IBCF.

Step 37. The (ingress) IBCF passes the SIP 200 OK message to the originating network via the originating network IBCF.

Step 38. At this point a two-way connection is established between the caller and the PSAP.

Step 39. (Optional) The legacy PSAP sends an ALI re-bid query (containing the callback information and/or pANI received in Step 22) to the LPG.

Step 40. (Optional) The LPG queries the originating LRF (as identified in the LbyR URI that is associated with the Reference Identifier) for updated (dispatch) location information (responseTime parameter = "emergencyDispatch" in this example).

Step 41. (Conditional on Step 40) The originating LRF queries the LS for updated (dispatch) location. (Note that the value of the responseTime parameter [emergencyDispatch or a specific time value] will be used by the LRF to determine whether to query the LS.)

Step 42. (Conditional on Step 41) The LS returns updated (dispatch) location information to the originating LRF.

Step 43. (Conditional on Step 40) The LRF in the IMS-based originating network supplies updated (dispatch) location to the LPG.

Step 44. (Conditional on Step 39) The LPG supplies updated (dispatch) location (along with callback and other non-location information, as appropriate for the interface) for display at the legacy PSAP.

Step 45. At some point the call is terminated. In this call flow, the PSAP terminates the call and sends an on-hook indication to the LPG.

Step 46. The LPG maps the on-hook indication to a SIP BYE message and sends the SIP BYE message to the (egress) IBCF.

Step 47. The (egress) IBCF passes the SIP BYE message to the E-CSCF.

Step 48. (Conditional on Step 11) The E-CSCF then notifies the LRF that the call has terminated.

Step 49. The E-CSCF passes the SIP BYE message to the (ingress) IBCF.

Step 50. The (ingress) IBCF passes the SIP BYE message to the originating network via the originating network IBCF.

8.5 Non-IMS Originating Network to i3 and Legacy PSAPs – LbyV

8.5.1 Delivery of Emergency Call Origination from Non-IMS Origination Network to i3 PSAP with LbyV

The call flow provided in Figure 8-11 illustrates a scenario where an emergency call is delivered by a non-IMS origination network to an IMS-based NG9-1-1 Emergency Services Network with LbyV. Upon detecting an emergency origination, the calling device requests location by querying a Location Information Server (LIS)[21] in the access network, using the HELD protocol. The HELD locationRequest contains an identifier associated with the calling device and appropriate credentials. It also contains an indication of the form that the provided location information should take. In this example call flow, the device requests a civic or geodetic location. The LIS responds with location information (i.e., LbyV). The device uses the location information returned in the HELD locationResponse to query an Emergency Call Routing Function (ECRF) for routing information. The ECRF returns a URI associated with the I-CSCF in an IMS-based NG9-1-1 Emergency Services Network. The device forwards the emergency session request to a Call Server/Proxy in its serving non-IMS i3-compliant originating network. The SIP INVITE message signaled by the device to the Call Server/Proxy includes a Route header that contains the URI of an I-CSCF in the IMS-based NG9-1-1 Emergency Services Network, an emergency services service URN (urn:service:sos) in the Request-URI, callback information in the P-Asserted-Identity header, and LbyV in the message body. (A Geolocation header that contains a Content-ID (cid) pointing to the PIDF-LO in the message body, a Geolocation-Routing header set to “yes”, and other SIP headers will also be included in the SIP INVITE message, but are not specifically illustrated in Figure 8-11.) The Call Server/Proxy adds Additional Data “by value” to the body of the SIP INVITE message, along with a Call-Info header that contains a cid pointing to the Additional Data in the message body, and forwards the SIP INVITE to an IBCF on the ingress side of the IMS-based NG9-1-1 Emergency Services Network. The IBCF forwards the SIP INVITE to the I-CSCF, and the I-CSCF forwards the SIP INVITE message to the pre-configured E-CSCF, populating the E-CSCF URI in the Route header. The E-CSCF forwards the SIP INVITE to the LRF. The LRF uses the LbyV to query the RDF. In this example call flow, the Route URI that is returned by the RDF is associated with an i3 PSAP. Figure 8-11 shows the emergency call then being delivered to the i3 PSAP with the same LbyV as was received by the IMS-based NG9-1-1 Emergency Services Network in incoming signaling from the non-IMS originating network, as well as Additional Data (by value).

[21] NENA defines a LIS as a functional element that provides the locations of endpoints either by-reference or by-value, and if by-value, in geo or civic format. A LIS can be queried by an endpoint for its own location or by another entity for the location of an endpoint. The LIS is also the entity that provides the dereferencing service, exchanging a location reference for a location value.

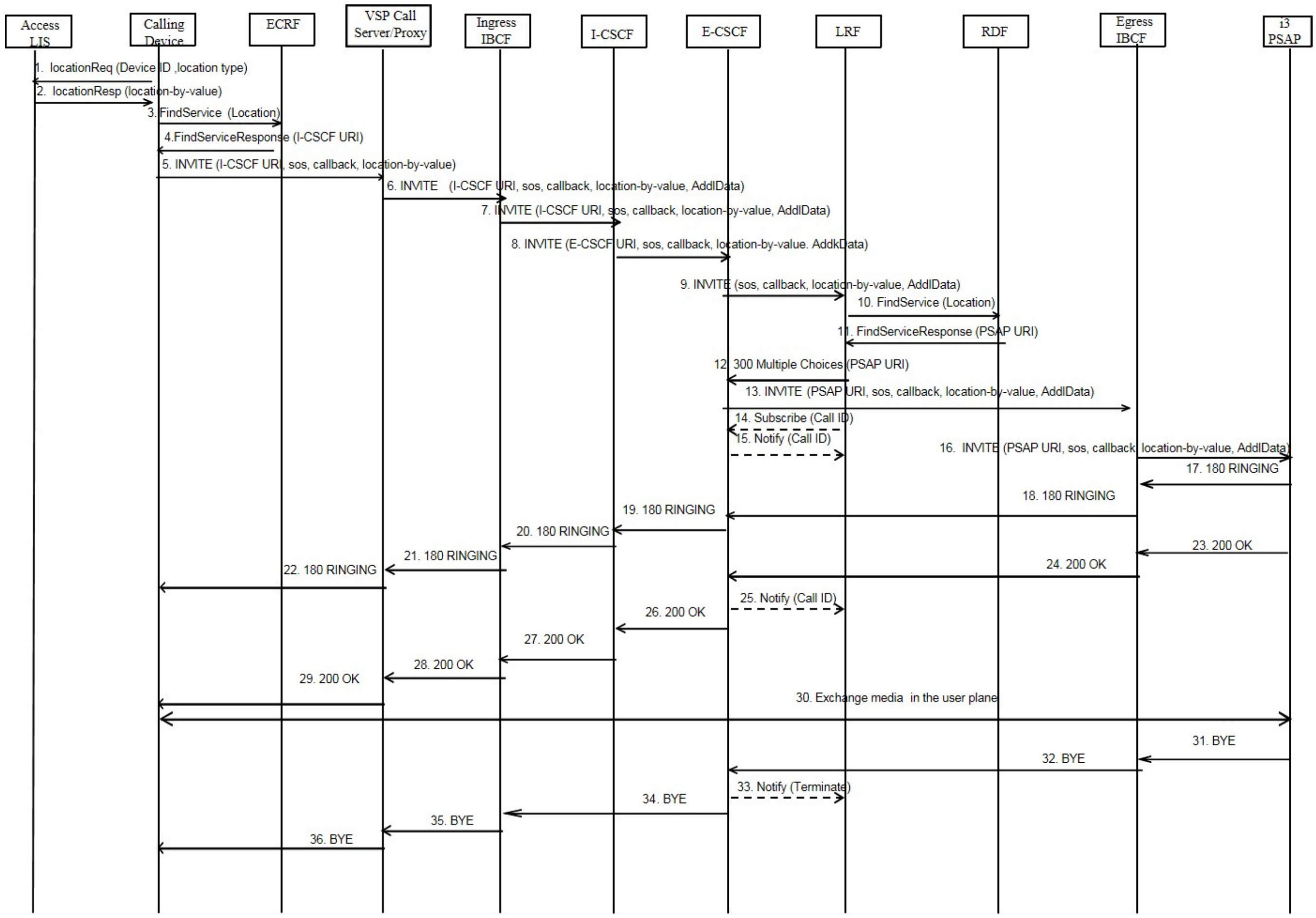

Figure 8-11: Delivery of Non-IMS Emergency Call Origination to i3 PSAP with LbyV

Step 1. Upon recognizing a request for emergency service, the calling device requests location by querying the LIS in the access network. (This example illustrates the use of the HELD protocol for the location request.) The locationRequest contains an identifier and appropriate credentials associated with the calling device, as well as an indication of the type of location being requested. In this example, the device requests civic or geodetic location. The locationRequest also includes a responseTime parameter (not shown) indicating how long the device is prepared to wait for a response or the purpose for which the device needs the location.

Step 2. The LIS responds to the location request by returning location information “by-value”.

Step 3. The device uses the LbyV in the location response from the LIS and the emergency service URN (urn:service:sos) to query an ECRF for routing information.

Step 4. The ECRF responds by returning a URI associated with an I-CSCF in an IMS-based NG9-1-1 Emergency Services Network.

Step 5. The device generates a SIP INVITE message that includes a Route header that contains the I-CSCF URI, an emergency services service URN (urn:service:sos), callback information, and LbyV (i.e., a Geolocation header that contains a cid, a Geolocation-Routing header set to “yes”, and a PIDF-LO in the body of the message that contains the LbyV), and sends it to a Call Server/Proxy in its serving non-IMS originating network.

Step 6. The Call Server/Proxy adds Additional Data “by value” to the received SIP INVITE message by including a Call-Info header that contains a cid pointing to the Additional Data in the message body, and forwards the SIP INVITE message to an IBCF on the ingress side of the IMS-based NG9-1-1 Emergency Services Network.

Step 7. The (ingress) IBCF forwards the received INVITE message to the I-CSCF.

Step 8. The I-CSCF determines the address of the E-CSCF (based on provisioned data) and forwards the SIP INVITE message to it. 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. 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 11. The RDF returns a Route URI. In this example, the Route URI is associated with an i3 PSAP that is served by the IMS-based NG9-1-1 Emergency Services Network.

Step 12. The LRF redirects the call back to the E-CSCF, passing the Route (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 PSAP URI 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. (Optional) The LRF may subscribe to the state of the call.

Step 15. (Conditional on Step 14) The E-CSCF sends an initial notification of the call state.

Step 16. The (egress) IBCF forwards the SIP INVITE message to the i3 PSAP with the callback information, the LbyV, and Additional Data received in the initial SIP INVITE message from the IMS originating network.

Step 17. An indication that the call taker is being alerted is returned by the i3 PSAP to the (egress) IBCF (using a SIP 180 RINGING message).

Step 18. The IBCF passes the SIP 180 RINGING message to the E-CSCF.

Step 19. The E-CSCF passes the SIP 180 RINGING message to the I-CSCF.

Step 20. The I-CSCF passes the SIP 180 RINGING message to the (ingress) IBCF.

Step 21. The (ingress) IBCF passes the SIP 180 RINGING message to the Call Server/Proxy in the non-IMS originating network.

Step 22. The Call Server/Proxy passes the SIP 180 RINGING message to the calling device.

Step 23. When the PSAP answers the call, it returns a SIP 200 OK message to the (egress) IBCF.

Step 24. The (egress) IBCF passes the SIP 200 OK message to the E-CSCF.

Step 25. (Conditional on Step 14) The E-CSCF sends a notification to the LRF updating the call state.

Step 26. The E-CSCF passes the SIP 200 OK message to the I-CSCF.

Step 27. The I-CSCF passes the SIP 200 OK message to the (ingress) IBCF.

Step 28. The (ingress) IBCF passes the SIP 200 OK message to the Call Server/Proxy in the non-IMS originating network.

Step 29. The Call Server/Proxy passes the SIP 200 OK message to the calling device.

Step 30. At this point a two-way connection is established between the caller and the PSAP.

Step 31. At some point the call is terminated. In this call flow, the PSAP terminates the call and sends a SIP BYE message to the (egress) IBCF.

Step 32. The SIP BYE is passed from the (egress) IBCF to the E-CSCF.

Step 33. (Conditional on Step 14) The E-CSCF then notifies the LRF that the call has terminated.

Step 34. The E-CSCF passes the SIP BYE message to the (ingress) IBCF.

Step 35. The (ingress) IBCF passes the SIP BYE message to the Call Server/Proxy in the non-IMS originating network.

Step 36. The Call Server/Proxy passes the SIP BYE message to the calling device.

8.5.2 Delivery of Emergency Call Origination from Non-IMS Origination Network to Legacy PSAP with LbyV

The call flow provided in Figure 8-12 illustrates a scenario where an emergency call is delivered by a non-IMS origination network to an IMS-based NG9-1-1 Emergency Services Network with LbyV. Upon detecting an emergency origination, the calling device requests location by querying a Location Information Server (LIS) in the access network, using the HELD protocol. The HELD locationRequest contains an identifier associated with the calling device and appropriate credentials. It also contains an indication of the form that the provided location information should take. In this example call flow, the device requests a civic or geodetic location. The LIS responds with location information (i.e., LbyV). The device uses the location information returned in the HELD locationResponse to query an Emergency Call Routing Function (ECRF) for routing information. The ECRF returns a URI associated with the I-CSCF in an IMS-based NG9-1-1 Emergency Services Network. The device forwards the emergency session request to a Call Server/Proxy in its serving non-IMS i3-compliant originating network. The SIP INVITE message signaled by the device to the Call Server/Proxy includes a Route header that contains the URI of an I-CSCF in the IMS-based NG9-1-1 Emergency Services Network, an emergency services service URN (urn:service:sos) in the Request-URI, callback information in the P-Asserted-Identity header, and LbyV in the message body. (A Geolocation header that contains a Content-ID (cid) pointing to the PIDF-LO in the message body, a Geolocation-Routing header set to “yes”, and other SIP headers will also be included in the SIP INVITE message, but are not specifically illustrated in Figure 8-12.) The Call Server/Proxy adds Additional Data “by value” to the body of the SIP INVITE message, along with a Call-Info header that contains a cid pointing to the Additional Data in the message body, and forwards the SIP INVITE to an IBCF on the ingress side of the IMS-based NG9-1-1 Emergency Services Network. The (ingress) IBCF forwards the SIP INVITE to the I-CSCF, and the I-CSCF forwards the SIP INVITE message to the pre-configured E-CSCF, populating the E-CSCF URI in the Route header. The E-CSCF forwards the SIP INVITE to the LRF. The LRF uses the LbyV to query the RDF. In this example call flow, the Route URI that is returned by the RDF is associated with a legacy PSAP. The call is forwarded via an (egress) IBCF to an i3 LPG with the LbyV and Additional Data (by value) that was provided to the IMS-based NG9-1-1 Emergency Services Network by the non-IMS originating network. In the call flow depicted in Figure 8-12, the LPG may generate a 7/10-digit pANI for the call and, based on per-PSAP provisioning, associates an appropriate Numbering Plan Digit (NPD) or ANI II value with the call (depending on whether the PSAP supports a Traditional MF interface or an Enhanced MF interface).

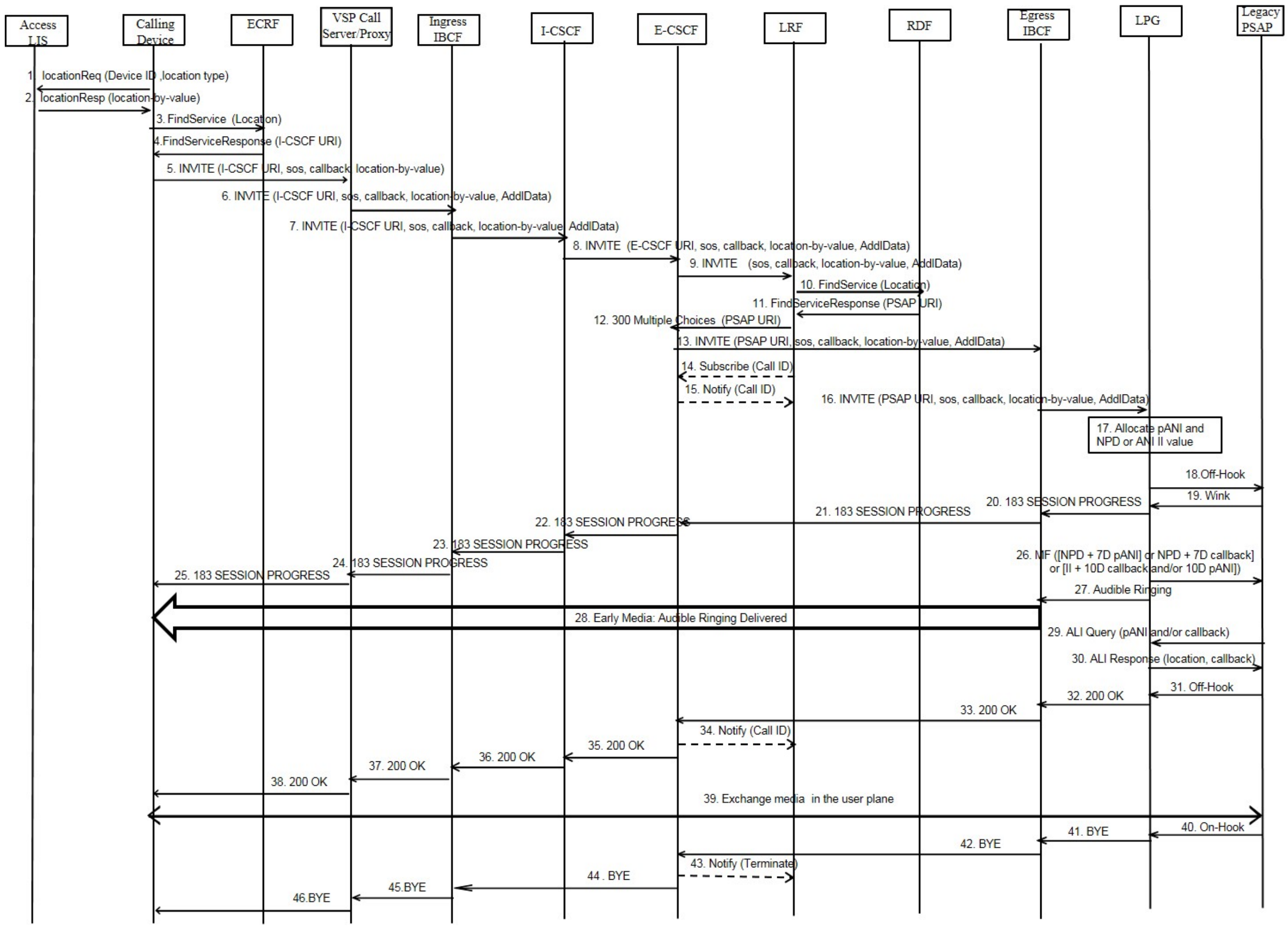

Figure 8-12: Delivery of Non-IMS Emergency Call Origination to Legacy PSAP with LbyV

Step 1. Upon recognizing a request for emergency service, the calling device requests location by querying the LIS in the access network. (This example illustrates the use of the HELD protocol for the location request.) The locationRequest contains an identifier and appropriate credentials associated with the calling device, as well as an indication of the type of location being requested. In this example, the device requests civic or geodetic location. The locationRequest also includes a responseTime parameter (not shown) indicating how long the device is prepared to wait for a response or the purpose for which the device needs the location.

Step 2. The LIS responds to the location request by returning location information “by-value”.

Step 3. The device uses the LbyV in the location response from the LIS and the emergency service URN (urn:service:sos) to query an ECRF for routing information.

Step 4. The ECRF responds by returning a URI associated with an I-CSCF in an IMS-based NG9-1-1 Emergency Services Network.

Step 5. The device generates a SIP INVITE message that includes a Route header that contains the I-CSCF URI, an emergency services service URN (urn:service:sos), callback information, and LbyV (i.e., a Geolocation header that contains a cid, a Geolocation-Routing header set to “yes” and a PIDF-LO in the body of the message that contains the LbyV), and sends it to a Call Server/Proxy in its serving non-IMS originating network.

Step 6. The Call Server/Proxy adds Additional Data (by value) to the received SIP INVITE message by including a Call-Info header that contains a cid pointing to the Additional Data in the message body, and forwards the SIP INVITE message to an IBCF on the ingress side of the IMS-based NG9-1-1 Emergency Services Network.

Step 7. The IBCF forwards the received INVITE message to the I-CSCF.

Step 8. The I-CSCF determines the address of the E-CSCF (based on provisioned data) and forwards the SIP INVITE message to it. 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. 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 11. The RDF returns a Route URI. In this example, the Route URI is associated with a legacy PSAP that is served by the IMS-based NG9-1-1 Emergency Services Network.

Step 12. The LRF redirects the call back to the E-CSCF, passing the Route (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 includes the PSAP URI 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. (Optional) The LRF may subscribe to the state of the call.

Step 15. (Conditional on Step 14) The E-CSCF sends an initial notification of the call state.

Step 16. The (egress) IBCF forwards the SIP INVITE message to the LPG.

Step 17. The LPG determines, based on provisioning, whether the PSAP associated with the received PSAP URI supports a Traditional MF or Enhanced MF interface. Depending on the type of interface supported by the PSAP, the LPG may generate a pANI[22] and will assign an appropriate NPD or ANI II value to the call, following the procedures specified in Section 7.2.2 of NENA-STA-010.2.

Step 18. The LPG generates an off-hook signal toward the legacy PSAP.

Step 19. The legacy PSAP returns a wink signal back to the LPG.

Step 20. The LPG generates a 183 Session Progress message and sends it to the (egress) IBCF.

Step 21. The (egress) IBCF passes the 183 Session Progress message to the E-CSCF.

Step 22. The E-CSCF passes the 183 Session Progress message to the I-CSCF.

Step 23. The I-CSCF passes the 183 Session Progress message to the (ingress) IBCF.

Step 24. The (ingress) IBCF passes the SIP 183 Session Progress message to Call Server/Proxy in the non-IMS originating network.

Step 25. The Call Server/Proxy passes the SIP 183 Session Progress message to the calling device.

Step 26. The LPG delivers the call to the legacy PSAP, mapping the SIP signaling from the incoming INVITE message to the outgoing Traditional or Enhanced MF signaling sequences.

[22] If the PSAP expects delivery of a location key, or it expects the delivery of a callback number and the callback information received by the LPG in the SIP INVITE message is not in the form of, or easily converted to, a 10-digit NANP number, the LPG will generate a pANI.

- For PSAPs that support a Traditional MF interface where delivery of callback information is preferred, the LPG will map the information received in the From/P-Asserted-Identity headers of the incoming SIP INVITE message, if that information is in the form of (or easily converted to) a 10-digit NANP number with an appropriate NPA value. If the callback information is not in the form of (or easily converted to) a 10-digit NANP number, the LPG will populate the pANI generated in Step 17 in the outgoing MF signaling sequence. The outgoing signaling will also include the NPD value obtained in Step 17. The LPG will signal the NPD and 7-digit callback number or pANI in the MF ANI sequence KP + NPD + NXX XXXX + ST.
- For PSAPs that support a Traditional MF interface where delivery of location information is preferred, the LPG will populate the pANI generated in Step 17, along with an appropriate NPD digit (i.e., NPD + 7D pANI) in the MF ANI sequence KP + NPD + NXX XXXX + ST.
- For PSAPs that support an Enhanced MF interface with 10-digit delivery where delivery of callback information is preferred, the LPG will map the information received in the From/P-Asserted-Identity headers of the SIP INVITE message, if that information is in the form of (or easily converted to) a 10-digit NANP number with an appropriate NPA. If the callback information is not in the form of (or easily converted to) a 10-digit NANP number, the LPG will signal the pANI, generated in Step 17 in the outgoing MF signaling sequence. The LPG will signal the II digits derived in Step 17 plus the 10D pANI or 10D callback number to the PSAP in the MF ANI sequence KP + II + NPA NXX XXXX + ST´.
- For PSAPs that support an Enhanced MF interface with 10-digit delivery where delivery of location information is preferred, the LPG will populate the pANI it generated in Step 17, along with an appropriate II value (i.e., II digits plus the 10D pANI), in the MF ANI sequence KP + II + NPA NXX XXXX + ST´.
- For PSAPs that support an Enhanced MF interface with 20-digit delivery, the LPG will populate the pANI (representing the LbyV) that it generated in Step 17 and the callback information that it received in the From/PAI headers (or a pANI if the callback information is not in the form of, or easily converted to, a 10-digit NANP number), along with the II value allocated by the LPG in Step 17, to the MF sequence KP + II + NPA NXX XXXX + ST + KP + NPA NXX XXXX + ST, where the first 10-digit number is associated with the callback information from the PAI/From headers and the second 10-digit number contains the pANI associated with the LbyV.

Step 27. Audible ringing is returned by the legacy PSAP to the LPG.

Step 28. Audible ringing is passed to the originating device/caller.

Step 29. The legacy PSAP sends a location query to the LPG using a legacy ALI protocol. The ALI query includes the 10-digit callback information and/or pANI received in Step 26. (Note that this can happen any time after Step 26.)

Step 30. The LPG returns an ALI response to the legacy PSAP that includes location information, a callback number and other information (e.g., class of service), as appropriate for the interface.

Step 31. When the PSAP answers the call, it returns an off-hook signal to the LPG.

Step 32. In response to the off-hook signal, the LPG generates a SIP 200 OK message and passes it to the (egress) IBCF.

Step 33. The (egress) IBCF passes the SIP 200 OK message to the E-CSCF.

Step 34. (Conditional on Step 14) The E-CSCF sends a notification to the LRF updating the call state.

Step 35. The E-CSCF passes the SIP 200 OK message to the I-CSCF.

Step 36. The I-CSCF passes the SIP 200 OK message to the (ingress) IBCF.

Step 37. The (ingress) IBCF passes the SIP 200 OK message to the Call Server/Proxy in the non-IMS originating network.

Step 38. The Call Server/Proxy passes the SIP 200 OK message to the calling device.

Step 39. At this point a two-way connection is established between the caller and the PSAP.

Step 40. At some point the call is terminated. In this call flow, the PSAP terminates the call and sends an on-hook indication to the LPG.

Step 41. The LPG maps the on-hook indication to a SIP BYE message and sends the SIP BYE message to the (egress) IBCF.

Step 42. The (egress) IBCF passes the SIP BYE message to the E-CSCF.

Step 43. (Conditional on Step 14) The E-CSCF then notifies the LRF that the call has terminated.

Step 44. The E-CSCF passes the SIP BYE message to the (ingress) IBCF.

Step 45. The (ingress) IBCF passes the SIP BYE message to the Call Server/Proxy in the non-IMS originating network.

Step 46. The Call Server/Proxy passes the SIP BYE message to the calling device.

8.6 Non-IMS VoIP Originating Network to i3 and Legacy PSAPs – LbyR

8.6.1 Delivery of Emergency Call Origination from Non-IMS Origination Network to i3 PSAP with LbyR

The call flow provided in Figure 8-13 illustrates a scenario where an emergency call is delivered by a non-IMS i3-compliant VoIP origination network to an IMS-based NG9-1-1 Emergency Services Network with LbyR. Upon detecting an emergency origination, the calling device requests location by querying a Location Information Server (LIS) in the access network, using the HELD protocol. The HELD locationRequest contains an identifier associated with the calling device and appropriate credentials. It also contains an indication of the form that the provided location information should take. In this example call flow, the device requests geodetic location and a location URI. The LIS responds with geodetic location information and a location URI. The device uses the geodetic location returned in the HELD locationResponse to query an Emergency Call Routing Function (ECRF) for routing information. The ECRF returns a URI associated with the I-CSCF in an IMS-based NG9-1-1 Emergency Services Network. The device forwards the emergency session request to a Call Server/Proxy in its serving non-IMS, i3-compliant originating network. The SIP INVITE message signaled by the device to the Call Server/Proxy includes a Route header that contains the URI of an I-CSCF in the IMS-based NG9-1-1 Emergency Services Network, an emergency services service URN (urn:service:sos) in the Request-URI, callback information in the P-Asserted-Identity header, and a LbyR URI in the Geolocation header. (A Geolocation-Routing header set to “yes”, and other SIP headers will also be included in the SIP INVITE message, but are not specifically illustrated in Figure 8-13.) The Call Server/Proxy adds Additional Data “by reference” to the SIP INVITE message by including a Call-Info header that contains an Additional Data URI, and forwards the SIP INVITE to an IBCF on the ingress side of the IMS-based NG9-1-1 Emergency Services Network. The IBCF forwards the SIP INVITE to the I-CSCF, and the I-CSCF forwards the SIP INVITE message to the pre-configured E-CSCF, populating the E-CSCF URI in the Route header. The E-CSCF forwards the SIP INVITE to the LRF. The LRF de-references the received location URI by sending a de-reference request to the LIS in the access network. The LRF then uses the LbyV received in the de-reference response to query the RDF. The Route URI that is returned by the RDF is assumed to be associated with an i3 PSAP. Figure 8-13 shows the emergency call then being delivered to the i3 PSAP with the same LbyR and Additional Data “by reference” as was received by the IMS-based NG9-1-1 Emergency Services Network in incoming signaling from the non-IMS originating network.

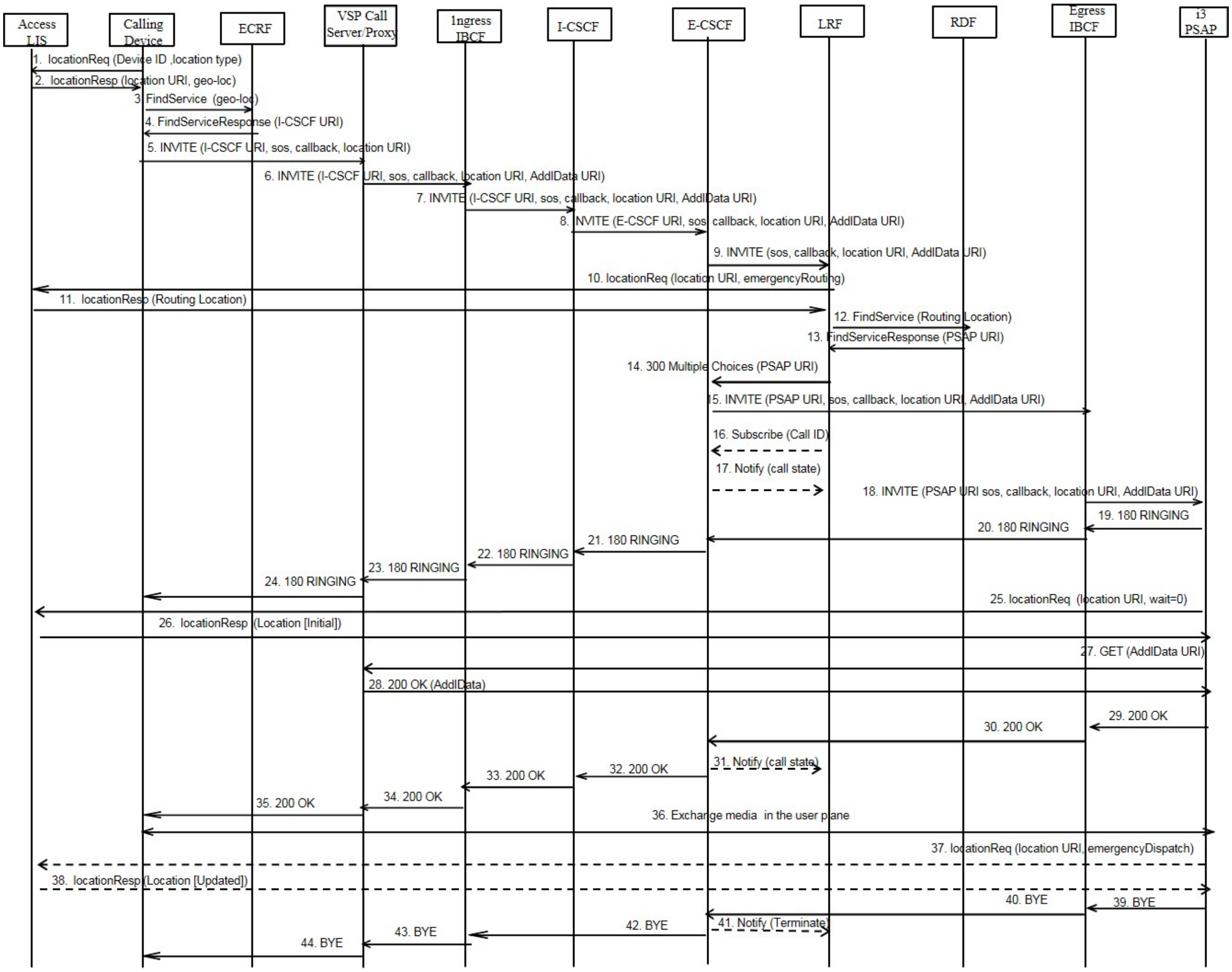

Figure 8-13: Delivery of Non-IMS Emergency Call Origination to i3 PSAP with LbyR

Step 1. Upon recognizing a request for emergency service, the calling device requests location by querying the LIS in the access network. (This example illustrates the use of the HELD protocol for the location request.) The locationRequest contains an identifier and appropriate credentials associated with the calling device, as well as an indication of the type of location being requested. In this example, the device requests geodetic location and a location URI. The locationRequest also includes a responseTime parameter (not shown) indicating how long the device is prepared to wait for a response or the purpose for which the device needs the location.

Step 2. The LIS responds to the location request by returning a geodetic location and a location URI.

Step 3. The device uses the geodetic location in the location response from the LIS and the emergency service URN (urn:service:sos) to query an ECRF for routing information.

Step 4. The ECRF responds by returning a URI associated with an I-CSCF in an IMS-based NG9-1-1 Emergency Services Network.

Step 5. The device generates a SIP INVITE message that includes a Route header that contains the I-CSCF URI, an emergency services service URN (urn:service:sos), callback information, and the location URI received from the LIS (along with a Geolocation-Routing header set to “yes”), and sends it to a Call Server/Proxy in its serving non-IMS originating network.

Step 6. The Call Server/Proxy adds Additional Data "by reference" to the received SIP INVITE message by including a Call-Info header that contains an Additional Data URI, and forwards the SIP INVITE message to an IBCF on the ingress side of the IMS-based NG9-1-1 Emergency Services Network.

Step 7. The (ingress) IBCF forwards the received INVITE message to the I-CSCF.

Step 8. The I-CSCF determines the address of the E-CSCF (based on provisioned data), and forwards the SIP INVITE message to it. 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, location URI, and Additional Data URI, as received in the incoming SIP INVITE message.

Step 9. The E-CSCF forwards the SIP INVITE to the LRF.

Step 10. In this example, the SIP INVITE contains a location URI, so the LRF in the IMS-based NG9-1-1 Emergency Services Network queries a LIS in the access network (as identified in the location URI) for the routing location (i.e., responseTime parameter = emergencyRouting).

Step 11. The LIS returns the Routing Location that is associated with the location URI.

Step 12. The LRF queries the RDF using the location information obtained in Step 11.

Step 13. The RDF returns a Route URI. In this example, the Route URI is associated with an i3 PSAP that is served by the IMS-based NG9-1-1 Emergency Services Network.[23]

Step 14. The LRF redirects the call back to the E-CSCF, passing the Route (PSAP) URI.

Step 15. 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 PSAP URI in the Route header, the sos service URN in the Request-URI, the callback information in the From and P-Asserted-Identity headers, a Call-Info header containing an Additional Data URI, and the location URI in the Geolocation header. (A Geolocation-Routing header set to "yes" will also be present in the SIP INVITE message, as well as other SIP headers per RFC 3261 [Ref 18]).

Step 16. (Optional) The LRF may subscribe to the state of the call.

Step 17. (Conditional on Step 16) The E-CSCF sends an initial notification of the call state.

Step 18. The (egress) IBCF forwards the SIP INVITE message to the i3 PSAP with the callback information, Additional Data URI, and location URI received by the IMS-based NG9-1-1 Emergency Services Network in the SIP INVITE message from the non-IMS originating network.

Step 19. An indication that the call taker is being alerted is returned by the i3 PSAP to the (egress) IBCF (using a SIP 180 RINGING message).

Step 20. The (egress) IBCF passes the SIP 180 RINGING message to the E-CSCF.

Step 21. The E-CSCF passes the SIP 180 RINGING message to the I-CSCF.

Step 22. The I-CSCF passes the SIP 180 RINGING message to the (ingress) IBCF.

Step 23. The (ingress) IBCF passes the SIP 180 RINGING message to the Call Server/Proxy in the originating network.

Step 24. The Call Server/Proxy in the originating network passes the SIP 180 RINGING message to the calling device.

[23] If policy associated with the Route URI returned by the RDF requires that the LRF obtain Additional Data, the LRF will also have to de-reference with the Call Server/Proxy in the originating network to obtain Additional Data "by value". This example assumes that the LRF does not need to obtain Additional Data to determine the destination PSAP for the call.

Step 25. Since the SIP INVITE message received by the i3 PSAP contains a location URI, the i3 PSAP queries the LIS in the access network (as identified in the location URI) for initial dispatch location (i.e., responseTime contains a wait timer value of “0”). (Note that this can occur any time after Step18.)

Step 26. The LIS supplies the initial dispatch location information to the PSAP. The initial display location information is displayed at the PSAP CPE.

Step 27. Since the SIP INVITE message received by the i3 PSAP also contains an Additional Data URI, the i3 PSAP queries the Call Server/Proxy in the originating network (or Additional Data Repository [ADR] associated with it), as identified in the Additional Data URI for Additional Data using a GET request. (Note that this can occur any time after Step18.)

Step 28. The Call Server/ADR returns Additional Data (by value) to the i3 PSAP.

Step 29. When the i3 PSAP answers the call, it returns a SIP 200 OK message to the (egress) IBCF.

Step 30. The (egress) IBCF passes the SIP 200 OK message to the E-CSCF.

Step 31. (Conditional on Step 16) The E-CSCF sends a notification to the LRF updating the call state.

Step 32. The E-CSCF passes the SIP 200 OK message to the I-CSCF.

Step 33. The I-CSCF passes the SIP 200 OK message to the (ingress) IBCF.

Step 34. The (ingress) IBCF passes the SIP 200 OK message to the Call Server/Proxy in the originating network.

Step 35. The Call Server/Proxy passes the SIP 200 OK message to the calling device.

Step 36. At this point a two-way connection is established between the caller and the PSAP.

Step 37. (Optional) The PSAP queries the LIS in the access network (as identified in the location URI) for updated (dispatch) location information (responseTime parameter = “emergencyDispatch” in this example).

Step 38. (Conditional on Step 37) The LIS in the access network supplies the updated (dispatch) location to the i3 PSAP and it is displayed on the PSAP CPE.

Step 39. At some point the call is terminated. In this call flow, the i3 PSAP terminates the call and sends a SIP BYE message to the (egress) IBCF.

Step 40. The SIP BYE is passed from the (egress) IBCF to the E-CSCF.

Step 41. (Conditional on Step 16) The E-CSCF then notifies the LRF that the call has terminated.

Step 42. The E-CSCF passes the SIP BYE message to the (ingress) IBCF.

Step 43. The (ingress) IBCF passes the SIP BYE message to the Call Server/Proxy in the originating network.

Step 44. The Call Server/Proxy passes the SIP BYE message to the calling device.

8.6.2 Delivery of Emergency Call Origination from Non-IMS Origination Network to Legacy PSAP with LbyR

The call flow provided in Figure 8-14 illustrates a scenario where an emergency call is delivered by a non-IMS i3-compliant VoIP origination network to an IMS-based NG9-1-1 Emergency Services Network with LbyR. Upon detecting an emergency origination, the calling device requests location by querying a Location Information Server (LIS) in the access network, using the HELD protocol. The HELD locationRequest contains an identifier associated with the calling device and appropriate credentials. It also contains an indication of the form that the provided location information should take. In this example call flow, the device requests geodetic location and a location URI. The LIS responds with geodetic location information and a location URI. The device uses the geodetic location returned in the HELD locationResponse to query an Emergency Call Routing Function (ECRF) for routing information. The ECRF returns a URI associated with the I-CSCF in an IMS-based NG9-1-1

Emergency Services Network. The device forwards the emergency session request to a Call Server/Proxy in its serving non-IMS, i3-compliant originating network. The SIP INVITE message signaled by the device to the Call Server/Proxy includes a Route header that contains the URI of an I-CSCF in the IMS-based NG9-1-1 Emergency Services Network, an emergency services service URN (urn:service:sos) in the Request-URI, callback information in the P-Asserted-Identity header, and a LbyR URI in the Geolocation header. (A Geolocation-Routing header set to “yes”, and other SIP headers will also be included in the SIP INVITE message, but are not specifically illustrated in Figure 8-14.) The Call Server/Proxy forwards the SIP INVITE to an IBCF on the ingress side of the IMS-based NG9-1-1 Emergency Services Network. The IBCF forwards the SIP INVITE to the I-CSCF and the I-CSCF forwards the SIP INVITE message to the (pre-configured) E-CSCF, populating the E-CSCF URI in the Route header. The E-CSCF forwards the SIP INVITE to the LRF. The LRF de-references the received location URI by sending a de-reference request to the LIS in the access network. The LRF then uses the LbyV received in the de-reference response to query the RDF. In this example call flow, the Route URI that is returned by the RDF is associated with a legacy PSAP. The call flow depicted in Figure 8-14 assumes that the call is forwarded by the E-CSCF to the LPG via an egress IBCF. The LPG may generate a 7/10-digit pANI for the call and, based on per-PSAP provisioning, associates an appropriate Numbering Plan Digit (NPD) or ANI II value with the call (depending on whether the PSAP supports a Traditional MF interface or an Enhanced MF interface).

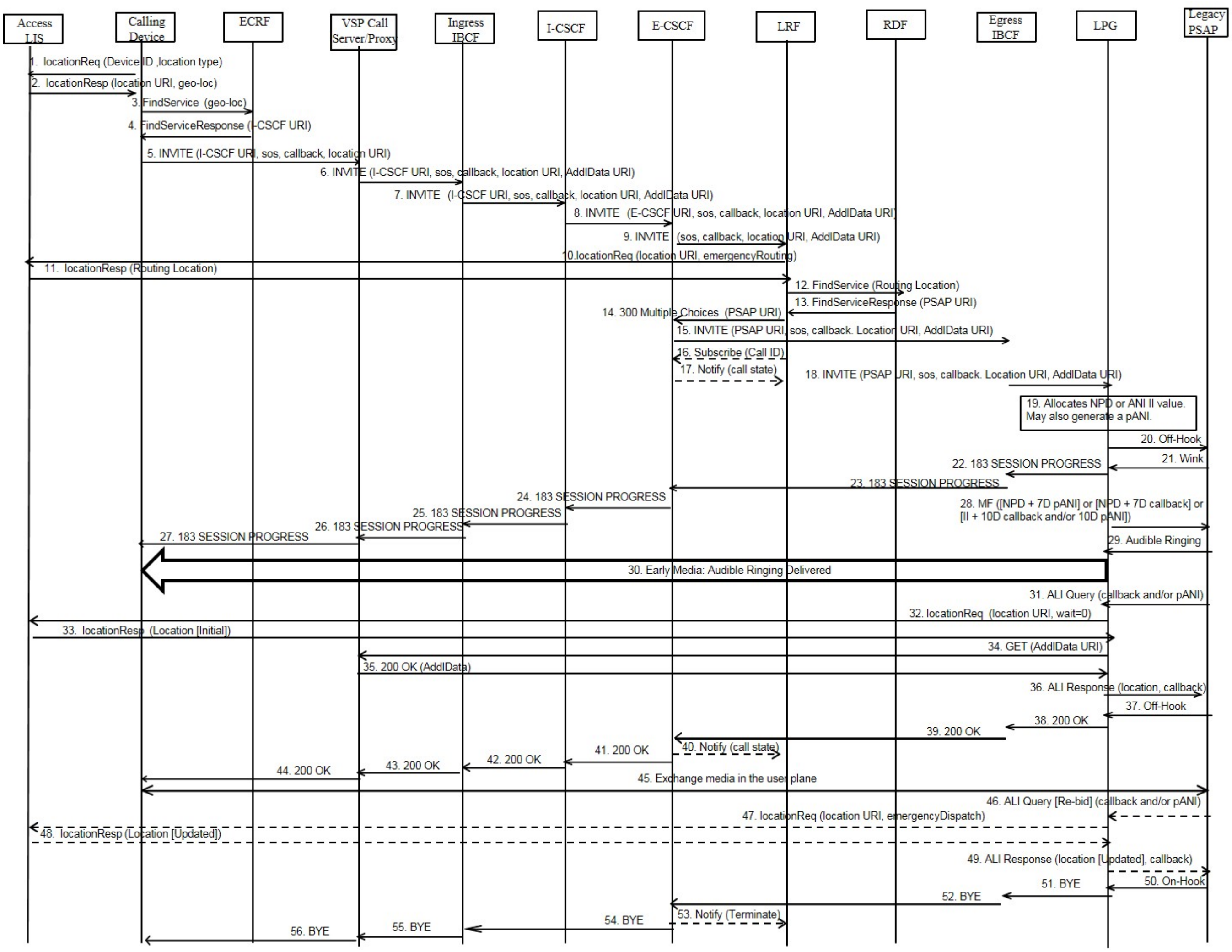

Figure 8-14: Delivery of Non-IMS Emergency Call Origination to Legacy PSAP with LbyR

Step 1. Upon recognizing a request for emergency service, the calling device requests location by querying the LIS in the access network. (This example illustrates the use of the HELD protocol for the location request.) The locationRequest contains an identifier and appropriate credentials associated with the calling device, as well as an indication of the type of location being requested. In this example, the device requests geodetic location and a location URI. The locationRequest also includes a responseTime parameter (not shown) indicating how long the device is prepared to wait for a response or the purpose for which the device needs the location.

Step 2. The LIS responds to the location request by returning a geodetic location and a location URI.

Step 3. The device uses the geodetic location in the location response from the LIS and the emergency service URN (urn:service:sos) to query an ECRF for routing information.

Step 4. The ECRF responds by returning a URI associated with an I-CSCF in an IMS-based NG9-1-1 Emergency Services Network.

Step 5. The device generates a SIP INVITE message that includes a Route header that contains the I-CSCF URI, an emergency services service URN (urn:service:sos), callback information, and the location URI received from the LIS, and sends it to a Call Server/Proxy in its serving non-IMS originating network.

Step 6. The Call Server/Proxy adds Additional Data (by reference) to the received SIP INVITE message by including a Call-Info header that contains an Additional Data URI and forwards the SIP INVITE message to an IBCF on the ingress side of the IMS-based NG9-1-1 Emergency Services Network.

Step 7. The (ingress) IBCF forwards the received INVITE message to the I-CSCF.

Step 8. The I-CSCF determines the address of the E-CSCF (based on provisioned data) and forwards the SIP INVITE message to the 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, location URI, and Additional Data (by reference) as received in the incoming SIP INVITE message.

Step 9. The E-CSCF forwards the SIP INVITE to the LRF.

Step 10. In this example, the SIP INVITE contains a LbyR URI, so the LRF in the IMS-based NG9-1-1 Emergency Services Network queries the LIS in the access network (as identified in the location URI) for routing location (i.e., responseTime parameter = emergencyRouting).

Step 11. The LIS returns the Routing Location that is associated with the location URI.

Step 12. The LRF queries the RDF using the location information obtained in Step 11 and the emergency service URN (urn:service:sos).

Step 13. The RDF returns a Route URI. In this example, the Route URI is associated with a legacy PSAP that is served by the IMS-based NG9-1-1 Emergency Services Network.

Step 14. The LRF redirects the call back to the E-CSCF, passing the Route (PSAP) URI.[24]

Step 15. 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 includes the PSAP URI in the Route header, the sos service URN in the Request-URI, the callback information in the From and P-Asserted-Identity headers, the LbyR URI in the Geolocation header, and an Additional Data URI in the Call-Info header. (A Geolocation-Routing header set to "yes" will also be present in the SIP INVITE message, as well as other SIP headers per RFC 3261 [Ref 18]).

Step 16. (Optional) The LRF may subscribe to the state of the call.

Step 17. (Conditional on Step 16) The E-CSCF sends an initial notification of the call state.

[24] If policy associated with the Route URI returned by the RDF requires that the LRF obtain Additional Data, the LRF will also have to de-reference with the Call Server/Proxy in the originating network to obtain Additional Data "by value". This example assumes that the LRF does not need to obtain Additional Data to determine the destination PSAP for the call.

Step 18. The (egress) IBCF forwards the SIP INVITE to the LPG.

Step 19. The LPG determines, based on provisioning, whether the PSAP associated with the received PSAP URI supports a Traditional MF or Enhanced MF interface. Depending on the type of interface supported by the PSAP, the LPG may generate a pANI and will assign an appropriate NPD or ANI II value to the call, following the procedures specified in Section 7.2.2 of NENA-STA-010.

Step 20. The LPG generates an off-hook signal toward the legacy PSAP.

Step 21. The legacy PSAP returns a wink signal back to the LPG.

Step 22. The LPG generates a 183 Session Progress message and sends it to the (egress) IBCF.

Step 23. The (egress) IBCF passes the 183 Session Progress message to the E-CSCF.

Step 24. The E-CSCF passes the 183 Session Progress message to the I-CSCF.

Step 25. The I-CSCF passes the 183 Session Progress message to the (ingress) IBCF.

Step 26. The (ingress) IBCF passes the SIP 183 Session Progress message to the Call Server/Proxy in the originating network.

Step 27. The Call Server/Proxy passes the SIP 183 Session Progress message to the calling device.

Step 28. The LPG delivers the call to the legacy PSAP, mapping the SIP signaling from the incoming INVITE message to the outgoing Traditional or Enhanced MF signaling sequences, as described below:

- For PSAPs that support a Traditional MF interface where delivery of callback information is preferred, the LPG will map the information received in the From/P-Asserted-Identity headers of the incoming SIP INVITE message, if that information is in the form of (or easily converted to) a 10-digit NANP number with an appropriate NPA value. If the callback information is not in the form of (or easily converted to) a 10-digit NANP number, the LPG will populate the pANI generated in Step 19 in the outgoing MF signaling sequence. The outgoing signaling will also include the NPD value obtained in Step 19. The LPG will signal the NPD and 7-digit callback number or pANI in the MF ANI sequence KP + NPD + NXX XXXX + ST.

- For PSAPs that support a Traditional MF interface where delivery of location information is preferred, the LPG will populate the pANI generated in Step 19, along with an appropriate NPD digit (i.e., NPD + 7D pANI) in the MF ANI sequence KP + NPD + NXX XXXX + ST.

- For PSAPs that support an Enhanced MF interface with 10-digit delivery where delivery of callback information is preferred, the LPG will map the information received in the From/P-Asserted-Identity headers of the SIP INVITE message, if that information is in the form of (or easily converted to) a 10-digit NANP number with an appropriate NPA. If the callback information is not in the form of (or easily converted to) a 10-digit NANP number, the LPG will signal the pANI, generated in Step 19 in the outgoing MF signaling sequence. The LPG will signal the II digits derived in Step 19 plus the 10D pANI or 10D callback number to the PSAP in the MF ANI sequence KP + II + NPA NXX XXXX + ST´.

- For PSAPs that support an Enhanced MF interface with 10-digit delivery where delivery of location information is preferred, the LPG will populate the pANI it generated in Step 19, along with an appropriate II value (i.e., II digits plus the 10D pANI), in the MF ANI sequence KP + II + NPA NXX XXXX + ST´.

- For PSAPs that support an Enhanced MF interface with 20-digit delivery, the LPG will populate the pANI (associated with the location information) that it generated in Step 19 and the callback information that it received in the From/PAI headers (or a pANI if the callback information is not in the form of, or easily converted to, a 10-digit NANP number), along with the II value allocated by the LPG in Step 19, to the MF sequence KP + II + NPA NXX XXXX + ST + KP + NPA NXX XXXX + ST, where the first 10-digit number is associated with the callback information from the PAI/From headers and the second 10-digit number contains the pANI associated with the location.

Step 29. Audible ringing is returned by the legacy PSAP to the LPG.

Step 30. Audible ringing is passed to the originating device/caller.

Step 31. The legacy PSAP sends a location query to the LPG using a legacy ALI protocol. The ALI query includes the 10-digit callback information and/or the pANI received in Step 28. (Note that this can happen any time after Step 28.)

Step 32. The LPG sends a de-reference request to the LIS in the access network (as identified in the location URI associated with the pANI/callback information) for initial dispatch location (i.e., responseTime contains a wait timer value of “0”).

Step 33. The LIS supplies the initial dispatch location information to the LPG in the de-reference response.

Step 34. In this example, the SIP INVITE received by the LPG contains an Additional Data URI, so the LPG queries the Call Server/Proxy (as identified in the URI) for Additional Data using an HTTPS GET operation.

Step 35. The Call Server/Proxy provides the requested Additional Data in a 200 OK response.[25]

Step 36. The LPG returns an ALI response to the legacy PSAP that includes the initial dispatch location information, a callback number and other information (e.g., class of service), as appropriate for the interface.

Step 37. When the PSAP answers the call, it returns an off-hook signal to the LPG.

Step 38. In response to the off-hook signal, the LPG generates a SIP 200 OK message and passes it to the (egress) IBCF.

Step 39. The (egress) IBCF passes the SIP 200 OK message to the E-CSCF.

Step 40. (Conditional on Step 17) The E-CSCF sends a notification to the LRF updating the call state.

Step 41. The E-CSCF passes the SIP 200 OK message to the I-CSCF.

Step 42. The I-CSCF passes the SIP 200 OK message to the (ingress) IBCF.

Step 43. The (ingress) IBCF passes the SIP 200 OK message to the Call Server/Proxy in the originating network.

Step 44. The Call Server/Proxy passes the SIP 200 OK message to the calling device.

Step 45. At this point a two-way connection is established between the caller and the PSAP.

Step 46. (Optional) The legacy PSAP sends an ALI re-bid query (containing the callback information and/or pANI received in Step 28) to the LPG.

Step 47. (Optional) The LPG queries the LIS in the access network (as identified in the location URI that is associated with the pANI/callback information) for updated (dispatch) location information (responseTime parameter = “emergencyDispatch” in this example).

Step 48. (Conditional on Step 47) The LIS in the access network supplies updated (dispatch) location to the LPG.

Step 49. (Conditional on Step 46) The LPG supplies updated (dispatch) location (along with callback and other non-location information, as appropriate for the interface) for display at the legacy PSAP.

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[25] Note that Steps 32 through 35 can happen any time after Step 28, and that Steps 32 and 33 can be performed either before or after Steps 34 and 35.

Step 50. At some point the call is terminated. In this call flow, the PSAP terminates the call and sends an on-hook indication to the LPG.

Step 51. The LPG maps the on-hook indication to a SIP BYE message and sends the SIP BYE message to the (egress) IBCF.

Step 52. The (egress) IBCF passes the SIP BYE message to the E-CSCF.

Step 53. (Conditional on Step 16) The E-CSCF then notifies the LRF that the call has terminated.

Step 54. The E-CSCF passes the SIP BYE message to the (ingress) IBCF.

Step 55. The (ingress) IBCF passes the SIP BYE message to the Call Server/Proxy in the originating network.

Step 56. The Call Server/Proxy passes the SIP BYE message to the calling device.

8.7 TTY Calls to Legacy/i3 PSAPs

8.7.1 TTY Calls from IMS Originating Network to Legacy PSAP via NG9-1-1

This call flow illustrates a scenario where an incoming TTY call from an IMS originating network is delivered to a legacy PSAP via NG9-1-1 network with LbyV. This call flow shows an incoming emergency call with audio and text media included in the SDP offer.

NOTE: The PRACK messages are not shown for simplicity.

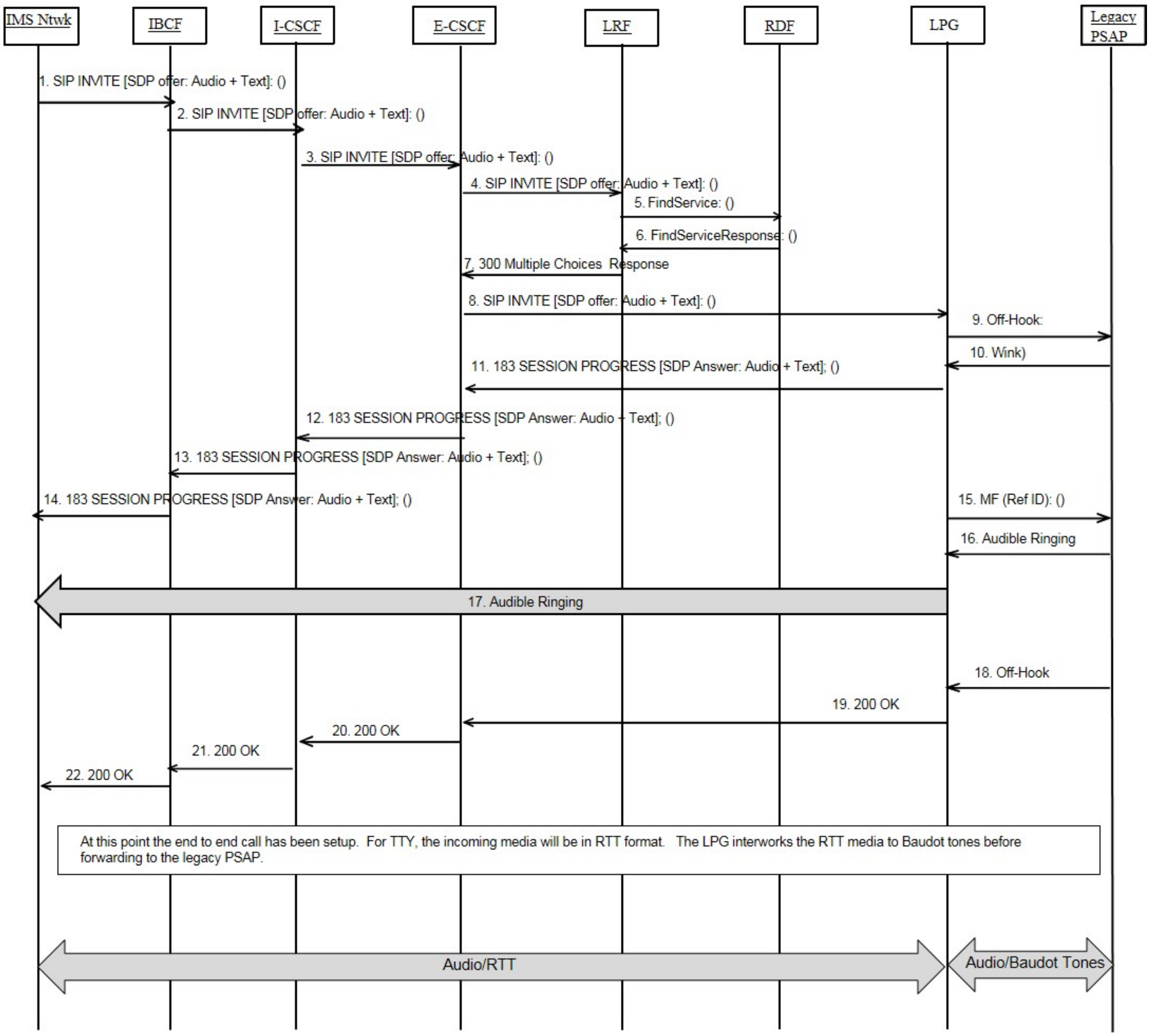

Figure 8-15: TTY Calls from IMS Originating Network to Legacy PSAP via NG9-1-1

Step 1. The IBCF in the IMS originating network sends an emergency call origination (i.e., a SIP INVITE) to the (ingress) IBCF in the NG9-1-1 network with an SDP offer of audio and RTT Text [Ref 29] media to be set up.

Step 2. The IBCF forwards the SIP INVITE to I-CSCF.

Step 3. The I-CSCF forwards the SIP INVITE to the pre-configured E-CSCF.

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.

Step 6. The RDF returns a Route URI. In this example, the Route URI is associated with a legacy PSAP that is served by the IMS-based NG9-1-1 Emergency Services Network.

Step 7. The LRF redirects the call back to the E-CSCF, passing the Route (PSAP) URI in 300 Multiple Choices response.

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 LPG.

Step 9. The LPG generates an Off Hook MF signal and forwards it to the legacy PSAP.

Step 10. The legacy PSAP returns a wink signal back to LPG.

Step 11. The LPG generates a SIP: 183 SESSION PROGRESS message (with an SDP Answer) back to E-CSCF.

Step 12. The E-CSCF forwards the SIP: 183 SESSION PROGRESS message to I-CSCF.

Step 13. The I-CSCF forwards the SIP: 183 SESSION PROGRESS message to NG9-1-1 IBCF.

Step 14. The NG9-1-1 IBCF forwards the SIP 183 SESSION PROGRESS message to IBCF of the originating IMS network.

Step 15. The LPG delivers the call to the legacy PSAP, mapping the SIP signaling from the incoming INVITE message to the outgoing Traditional or Enhanced MF signaling sequences.

Step 16. The legacy PSAP delivers Audible Ringing to LPG.

Step 17. The LPG delivers the Audible Ringing tone as early media to the originating network.

Step 18. When the PSAP answers the call, it returns an off-hook signal back to the LPG.

Step 19. In response to the off-hook signal, the LPG generates a SIP 200 OK message and passes it to the E-CSCF.

Step 20. The E-CSCF passes the SIP 200 OK message to the I-CSCF.

Step 21. The I-CSCF passes the SIP 200 OK message to the NG9-1-1 IBCF.

Step 22. The NG9-1-1 IBCF passes the SIP 200 OK message to the IMS originating network IBCF.

Once an emergency TTY call is set up the incoming audio and RTT media from an IMS originating network is forwarded to the LPG. The LPG, upon detecting the RTT media type, converts the RTT media to 45.5 Baudot tones before forwarding the data to the legacy PSAP.

8.7.2 TTY Calls from Legacy Originating Network to an i3 PSAP via NG9-1-1

This call flow illustrates a TTY emergency call originating in a legacy circuit switched network and terminated at an i3 PSAP. The i3 LNG sets up the call with an SDP offer of Audio + Text media in the initial SIP INVITE message. The call flow assumes LbyV.

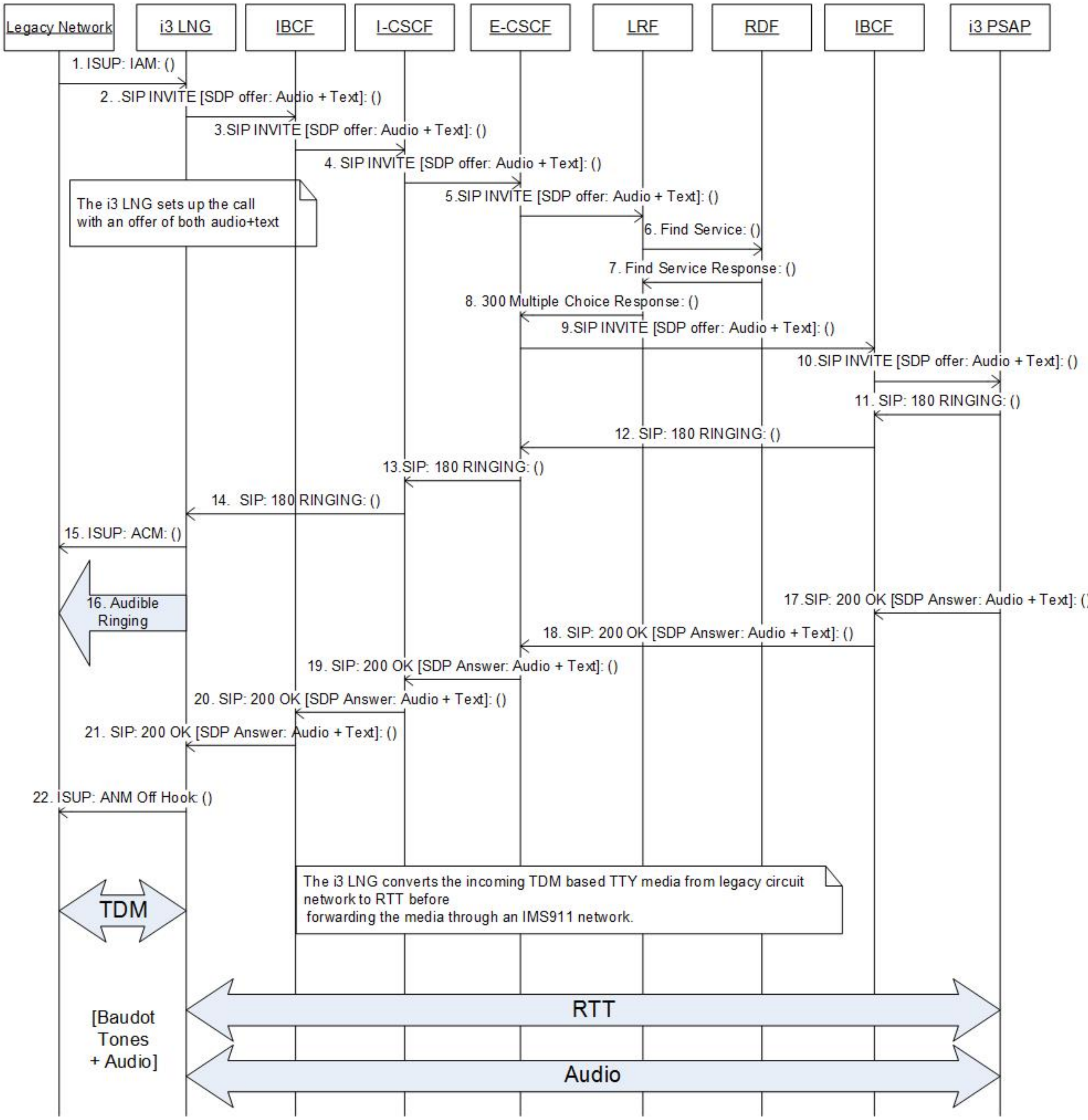

Figure 8-16: TTY Calls from Legacy Originating Network to an i3 PSAP via NG9-1-1

Step 1. The i3 LNG receives an SS7 IAM message from the legacy network.

Step 2. The i3 LNG translates the message into a SIP INVITE message with SDP offer of both Audio and Text media towards the IBCF.

Step 3. The IBCF forwards the SIP INVITE to I-CSCF.

Step 4. The I-CSCF forwards the SIP INVITE to the pre-configured E-CSCF.

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

Step 6. The LRF queries the RDF using the location information received in the body of the received SIP INVITE message.

Step 7. The RDF returns a Route URI. In this example, the Route URI is associated with an i3 PSAP that is served by the IMS-based NG9-1-1 Emergency Services Network.

Step 8. The LRF redirects the call back to the E-CSCF, passing the Route (PSAP) URI in 300 Multiple Choices response.

Step 9. 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.

Step 10. The IBCF forwards the INVITE to the i3 PSAP.

Step 11. The i3 PSAP sends a SIP: 180 RINGING to IBCF.

Step 12. The IBCF forwards the SIP: 180 RINGING message back to E-CSCF.

Step 13. The E-CSCF forwards the SIP: 180 RINGING message to I-CSCF.

Step 14. The I-CSCF forwards the SIP: 180 RINGING message to i3 LNG.

Step 15. The i3 LNG interworks the SIP: 180 RINGING message to an SS7 ACM indication towards the legacy network.

Step 16. The i3 LNG generates Audible Ringing towards Legacy network.

Step 17. When the PSAP answers the call, it returns a SIP: 200 OK message with [SDP Answer: Audio + Text] to the (egress) IBCF.

Step 18. The IBCF forwards the SIP: 200 OK message to E-CSCF.

Step 19. The E-CSCF passes the SIP: 200 OK message to the I-CSCF.

Step 20. The I-CSCF passed the SIP: 200 OK message to IBCF.

Step 21. The IBCF passes the SIP: 200 OK message to the i3 LNG.

Step 22. The i3 LNG interworks the SIP: 200 OK message to an SS7 ANM message towards the legacy network.

In this scenario, the incoming media from a legacy network will be 45.5 Baudot tones. The i3 LNG upon detecting the Baudot tones converts the media to RTT format [Ref 29] for transporting over the NG9-1-1 network. A separate Audio media is also established. Since the call is targeted towards an i3 PSAP, there is no further conversion needed and the media is forwarded as it is to the i3 PSAP.

8.7.3 TTY Calls from Legacy Originating Network to a Legacy PSAP via NG9-1-1

This call flow illustrates a TTY emergency call originating in a legacy circuit switched network terminated at a legacy PSAP. Similar to the scenario in Section 8.7.2, since the call originated in a legacy network, the i3 LNG will setup the incoming emergency call with both Audio + Text media. The assumption is that the incoming call is received by NG9-1-1 network with LbyV. On the egress side, the LPG would translate the Text media to Baudot tones before forwarding the media to the legacy PSAP.

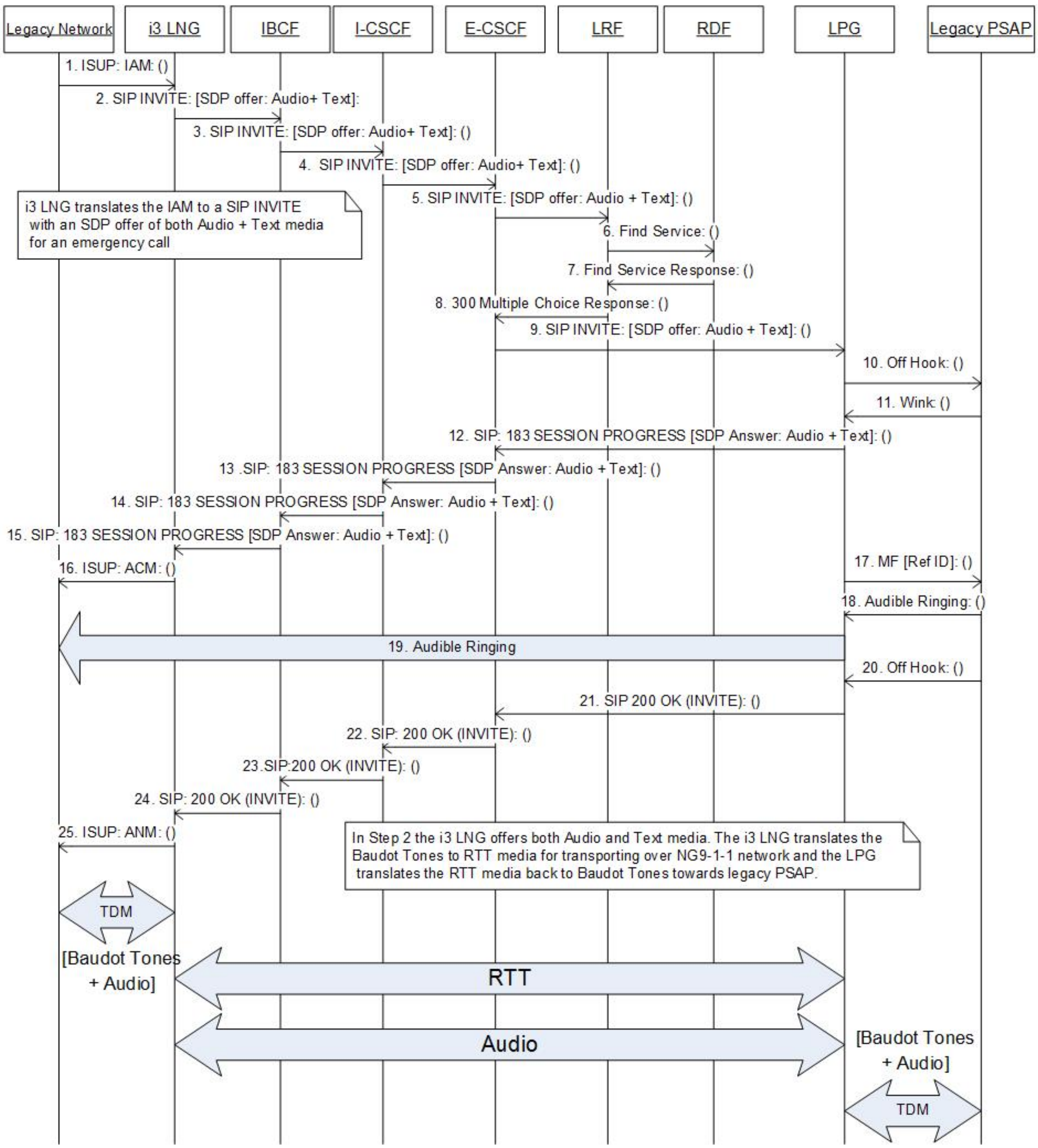

Figure 8-17: TTY Calls from Legacy Originating Network to a Legacy PSAP via NG9-1-1

Step 1. The ingress i3 LNG receives an SS7 IAM message from the legacy network.

Step 2. The i3 LNG detects an emergency call originating from a legacy network, interworks the incoming signaling to SIP with a request to setup both Audio + Text media, and forwards the SIP INVITE to the IBCF.

Step 3. The IBCF forwards the SIP INVITE to I-CSCF.

Step 4. The I-CSCF forwards the SIP INVITE to the pre-configured E-CSCF.

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

Step 6. The LRF queries the RDF using the location information received in the body of the received SIP INVITE message.

Step 7. The RDF returns a Route URI. In this example, the Route URI is associated with a legacy PSAP that is served by the IMS-based NG9-1-1 Emergency Services Network.

Step 8. The LRF redirects the call back to the E-CSCF, passing the Route (PSAP) URI in a 300 Multiple Choices response.

Step 9. 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 LPG. The SIP INVITE message contains the PSAP URI in the Route header.

Step 10. The LPG generates an off-hook signal toward the legacy PSAP.

Step 11. The legacy PSAP returns a wink signal back to the LPG.

Step 12. The LPG sends a SIP: 183 SESSION PROGRESS (with an SDP Answer) to the E-CSCF.

Step 13. The E-CSCF forwards the SIP: 183 SESSION PROGRESS message to I-CSCF.

Step 14. The I-CSCF forwards the SIP: 183 SESSION PROGRESS to the IBCF.

Step 15. The IBCF forwards the SIP: 183 SESSION PROGRESS to the i3 LNG.

Step 16. The i3 LNG interworks the SIP: 183 SESSION PROGRESS message to an SS7 ACM towards the legacy network.

Step 17. The LPG delivers the call to the legacy PSAP, mapping the SIP signaling from the incoming INVITE message to the outgoing Traditional or Enhanced MF signaling sequences. (Note that this can happen any time after step 11, in parallel with the 183 SESSION PROGRESS message being passed toward the i3 LNG.)

Step 18. The legacy PSAP sends Audible Ringing back to LPG.

Step 19. The Audible Ringing is delivered to the legacy network as Early Media: Audible Ringing Delivered.

Step 20. When the PSAP answers the call, it returns an off-hook signal back to the LPG.

Step 21. The LPG maps the off-hook signal to a SIP: 200 OK message and forwards the SIP: 200 OK message to the E-CSCF.

Step 22. The E-CSCF passes the SIP: 200 OK message to the I-CSCF.

Step 23. The I-CSCF passes the SIP: 200 OK message to the IBCF.

Step 24. The IBCF passes the SIP: 200 OK message to the i3 LNG.

Step 25. The i3 LNG maps the SIP: 200 OK message to an SS7 ANM message towards the legacy network.

The i3 LNG interworks the Baudot tones to RTT media per RFC 4103 [Ref 29] for transporting over an NG9-1-1 network. Since the call is directed towards a legacy PSAP, the LPG converts the RTT media to 45.5 Baudot tones and forwards it to the legacy PSAP.

8.8 Call Transfer/Bridging

A fundamental capability of E9-1-1/NG9-1-1 is the ability to transfer emergency calls. IMS-based NG9-1-1 Emergency Services Networks must support mechanisms to support the transfer of emergency calls between PSAPs that are served by the IMS-based NG9-1-1 Emergency Services Network. This includes transfers initiated by i3 PSAPs toward legacy PSAPs and other i3 PSAPs, as well as transfers initiated by legacy PSAPs toward i3 PSAPs and other legacy PSAPs.

The conferencing/transfer procedures are based on 3GPP TS 24.147 [Ref 11], RFC 4353 [Ref 13], NENA-STA-010.2 [Ref 27], RFC 4579 [Ref 22], and RFC 3891 [Ref 35].

The conference/transfer functions are provided by replacing the existing signaling/media path between the caller and the Primary PSAP with a new signaling/media path that involves the conferencing resources (e.g., MRFC/MRFP). This standard provides two methods of media anchoring:

- Conditionally at the Ingress point of the IMS emergency services network.
- At the Egress point of the IMS emergency services network.

The point that provides the signaling media anchoring within the IMS emergency services network shall be able to support “Replaces” header field present in an incoming INVITE request and act upon it according to RFC 3891 [Ref 35]. It shall also include the “Replaces” option tag in the Supported header field in the initial dialogue request.

Section 8.8.1 covers the Primary i3 PSAP scenario:

- Section 8.8.1.1 provides call flows that allow B2BUA functionality with header replacement and media anchoring at the originating network-facing IBCF when the signaling/media anchoring is done at the Ingress point for transfers initiated by a Primary i3 PSAP.
- Section 8.8.1.2 provides call flows that allow B2BUA functionality with header replacement and media anchoring at the Primary PSAP-facing IBCF when the signaling/media anchoring is done at the egress point for transfers initiated by a Primary i3 PSAP.

Section 8.8.2 covers the Primary Legacy PSAP scenario:

- Section 8.8.2.1 provides call flows that allow B2BUA functionality with header replacement and media anchoring at the Primary PSAP-facing IBCF when the signaling/media anchoring is done at the ingress point for transfers initiated by a Primary legacy PSAP.
- Section 8.8.2.2 provides call flows that allow B2BUA functionality with header replacement and media anchoring at the Primary PSAP-facing IBCF when the signaling/media anchoring is done at the egress point for transfers initiated by a Primary legacy PSAP.

8.8.1 Support for Emergency Call Transfer Requests from i3 PSAPs to Secondary PSAPs/Destinations

When an i3 PSAP initiates a transfer, it must first create a conference on a bridge. In the context of an IMS-based NG9-1-1 Emergency Services Network, this bridge will support multimedia (voice, video, text) and will reside in a conferencing Application Server (AS), as described in 3GPP TS 24.147 [Ref 11]. Bridging is necessary to support the transfer of emergency calls because in North America, emergency call transfer requires that a new party (e.g., a call taker at a Secondary PSAP) be added to the call before the transferor (i.e., the original call taker at the PSAP that initially answered the call) disconnects from the call, without the caller ever being put on hold.

For SIP-based conferences, the conferencing AS implements the role of a conference focus, as described in Section 5.3.2 of 3GPP TS 24.147. Media control for the conference is provided by a Media Resource Function Controller (MRFC) and media mixing is provided by a Media Resource Function Processor (MRFP) in the IMS-based NG9-1-1 Emergency Services Network. Consistent with Section 4 of 3GPP TS 24.147, these functional elements will be configured as depicted in Figure 8-18 below.

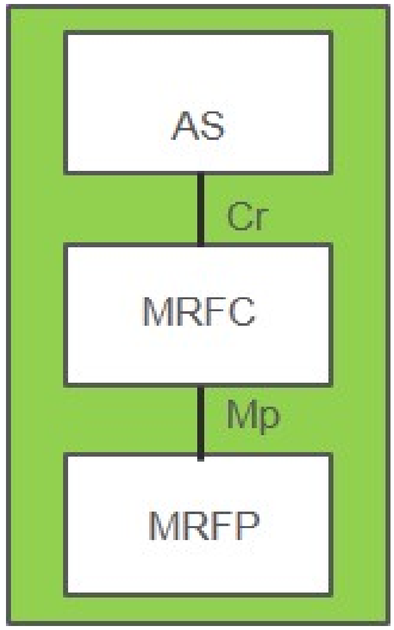

Figure 8-18: Conferencing Functional Architecture

3GPP TS 24.147 also describes the use of an Event package that allows conference participants to manage a conference by subscribing to the conference event package, as described in RFC 4575 [Ref 31].

The following subsections describe the flows associated with a transfer that is initiated by an i3 PSAP.

8.8.1.1 Signaling/Media Anchoring at Ingress Point Conditional on Supported Header

While the procedures described in RFC 4579 for establishing a SIP conference assume that the calling device supports the Replaces header, this standard does not assume or require support of the Replaces header by the calling device. In those cases where the Replaces header is not supported by the calling device, this Section describes transfer procedures in which the INVITE method with the Replaces header generated by the conferencing AS will be directed to an originating network-facing IBCF operating as a B2BUA rather than to the calling device. Specifically, if an originating network-facing IBCF in an IMS-based NG9-1-1 Emergency Services Network receives a SIP INVITE that does not include a Supported header containing the Replaces option-tag, it will act as a B2BUA (as described in Section 5.10 of 3GPP TS 24.229) and will include a Supported header containing the Replaces option-tag in the INVITE forwarded to the I-CSCF.

8.8.1.1.1 Conference Establishment

The flow depicted in Figure 8-19 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 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 the i3 PSAP via a PSAP-facing IBCF (not shown) that is operating as a proxy (or as a B2BUA that does not modify received headers, as described in RFC 7092 [Ref 33]). 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.

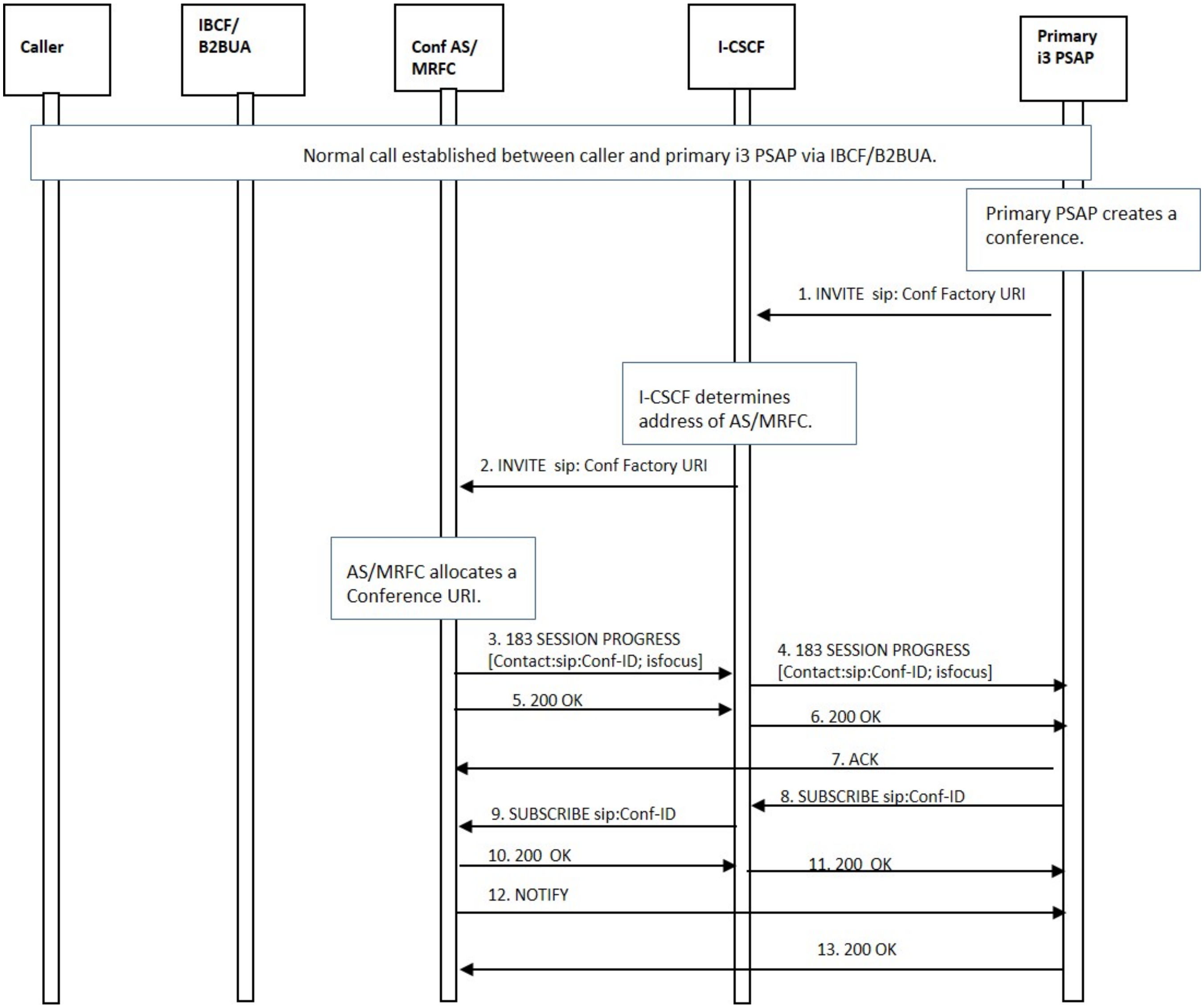

Figure 8-19: i3 PSAP Establishes Conference with Conferencing AS/MRFC

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 returns 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.

8.8.1.1.2 Primary PSAP Requests that the Conferencing AS Invite the IBCF/B2BUA to the Conference

Having established the conference, the Primary i3 PSAP asks the conferencing AS/MRFC to invite the IBCF/B2BUA to the conference. 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.

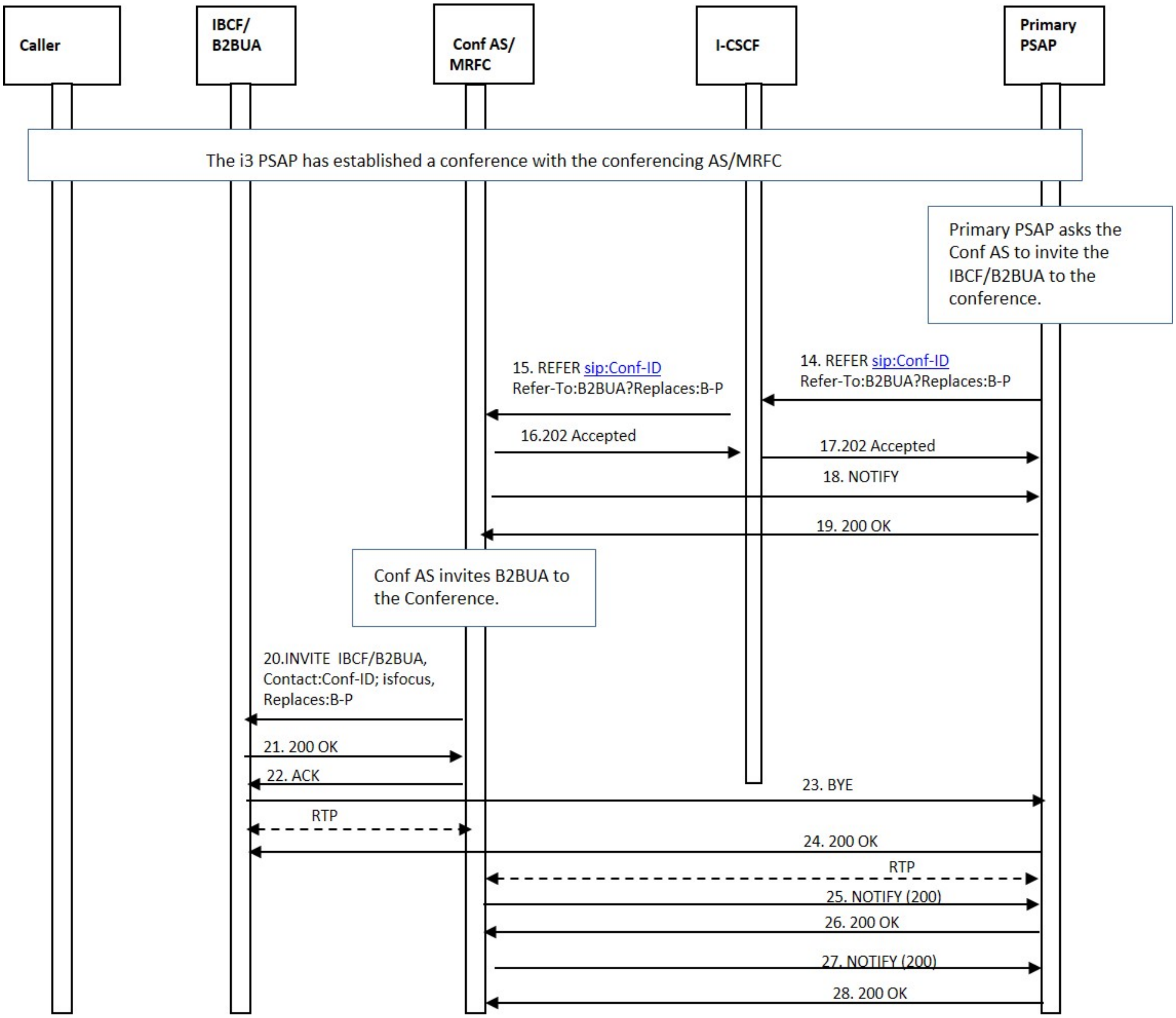

Figure 8-20: i3 PSAP Requests that IBCF/B2BUA be Invited to the Conference

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.

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]).

8.8.1.1.3 Primary PSAP Requests that the Conferencing AS Invite the Secondary PSAP to the Conference

Having invited the IBCF/B2BUA to the conference, the i3 PSAP then requests that the conferencing AS/MRFC invite the Secondary PSAP to the conference, using the mechanisms defined in RFC 4579, as illustrated in Figure 8-21 and Figure 8-22. 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 a Secondary 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 to the Secondary PSAP/LPG. The Secondary PSAP/LPG uses the EIDD reference URI to query the Primary PSAP for the EIDD.

8.8.1.1.3.1 Secondary PSAP is an i3 PSAP

Figure 8-21 illustrates a scenario where the Secondary PSAP is an i3 PSAP. (Note that all SIP messages between the Secondary i3 PSAP and the conferencing AS/MRFC flow via an IBCF [not shown].)

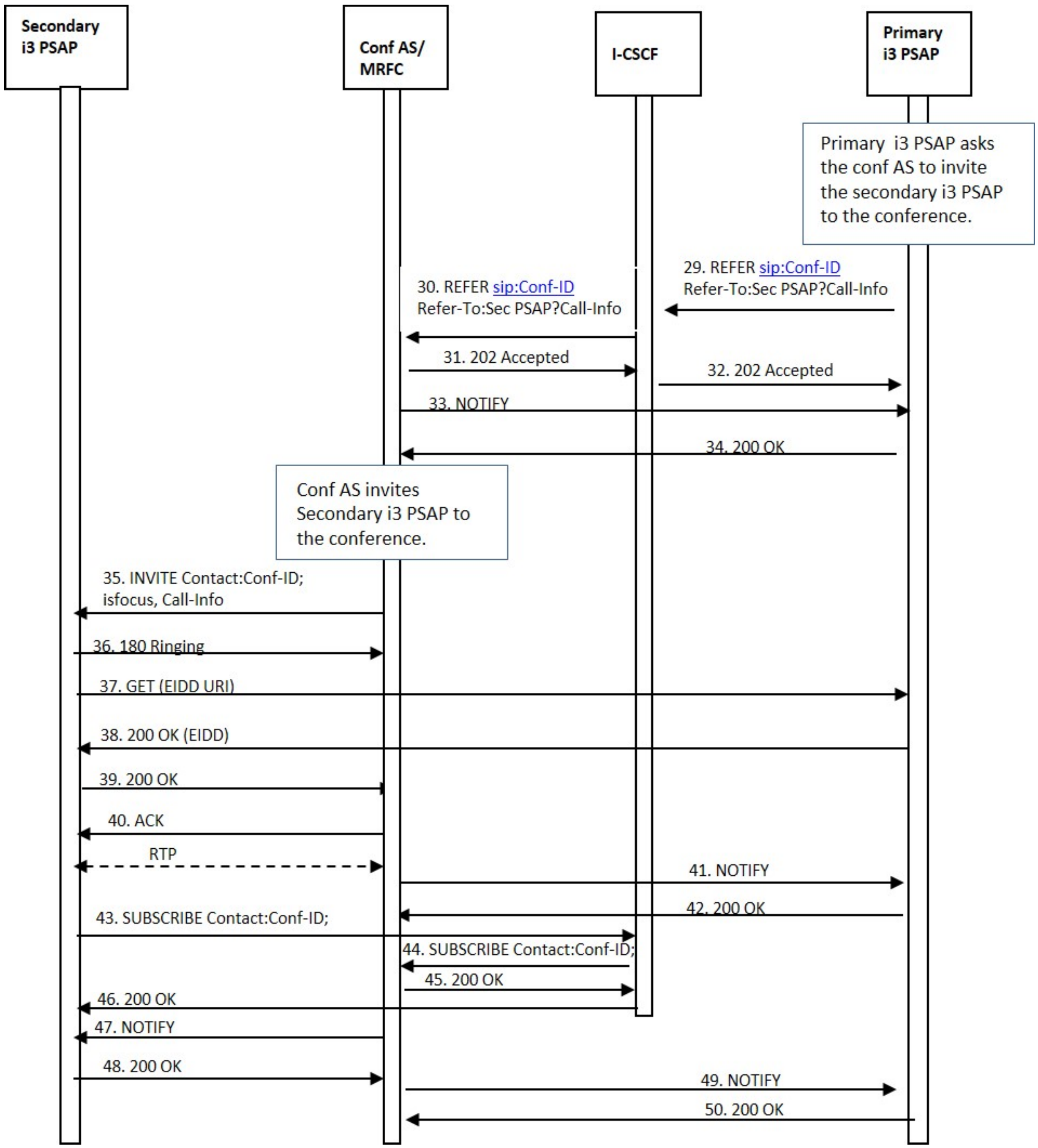

Figure 8-21: i3 PSAP Requests that a Secondary i3 PSAP be Invited to the Conference

Step 29. The Primary i3 PSAP sends a REFER method to the I-CSCF (via an IBCF [not shown]).

Step 30. 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 Secondary i3 PSAP to the conference. The REFER method contains the Conf-ID and a Refer-To header that contains the URI of the Secondary 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 31. The conferencing AS/MRFC returns a 202 Accepted message to the I-CSCF.

Step 32. The I-CSCF passes the 202 Accepted message (via an IBCF [not shown]) to the Primary i3 PSAP.

Step 33. The conferencing AS/MRFC then returns a NOTIFY message (via an IBCF [not shown]), indicating that subscription state of the REFER request (i.e., active).

Step 34. The Primary i3 PSAP returns a 200 OK message (via an IBCF [not shown]) in response to the NOTIFY message.

Step 35. The conferencing AS/MRFC invites the Secondary i3 PSAP to the conference by sending an INVITE method (via a Transit Function/IBCF [not shown]) containing the Conf-ID and Contact header that contains the conference URI and the isfocus feature parameter. The INVITE also contains the Call-Info header field containing a reference URI that points to the EIDD data structure and a purpose parameter of “eidd”. 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.

Step 36. The Secondary i3 PSAP UA responds by returning a 180 RINGING message (via the IBCF/Transit Function [not shown]) to the conferencing AS/MRFC.

Step 37. The Secondary i3 PSAP queries the Primary i3 PSAP for the EIDD by including the URI provided in the Call-Info header in Step 32 in a GET request.

Step 38. The Primary PSAP returns the EIDD to the Secondary i3 PSAP.

Step 39. The Secondary i3 PSAP accepts the invitation to the conference by returning a 200 OK message to the conferencing AS/MRFC (via the IBCF/Transit Function [not shown]).

Step 40. The conferencing AS/MRFC acknowledges receipt of the 200 OK message by returning an ACK.

A media session is established between the Secondary i3 PSAP and the conferencing AS/MRFC.

Step 41. The conferencing AS/MRFC returns 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 42. The Primary i3 PSAP responds to the NOTIFY message by returning a 200 OK message.

Step 43. The Secondary i3 PSAP subscribes to the conference associated with the Conf-ID provided in the INVITE message from the conferencing AS/MRFC by sending a SUBSCRIBE message to the I-CSCF (via the IBCF [not shown]).

Step 44. The I-CSCF passes the SUBSCRIBE message to the conferencing AS/MRFC.

Step 45. The conferencing AS/MRFC acknowledges the subscription request by sending a 200 OK message back to the I-CSCF.

Step 46. The I-CSCF passes the 200 OK message back to the Secondary i3 PSAP (via the IBCF [not shown]).

Step 47. The conferencing AS/MRFC then returns a NOTIFY message to the Secondary i3 PSAP (via the IBCF [not shown]) to provide subscription status information.

Step 48. The Secondary i3 PSAP responds by returning a 200 OK message.

Step 49. The conferencing AS/MRFC sends a NOTIFY message to the Primary i3 PSAP (via an IBCF [not shown]) providing updated status for the subscription associated with the REFER request.

Step 50. The Primary i3 PSAP responds to the NOTIFY message by returning a 200 OK message.

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

8.8.1.1.3.2 Secondary PSAP is a Legacy PSAP

Figure 8-22 illustrates a scenario where the Secondary PSAP is a legacy PSAP. (Note that all SIP messages between the Legacy PSAP Gateway and the conferencing AS/MRFC flow via an IBCF [not shown].)

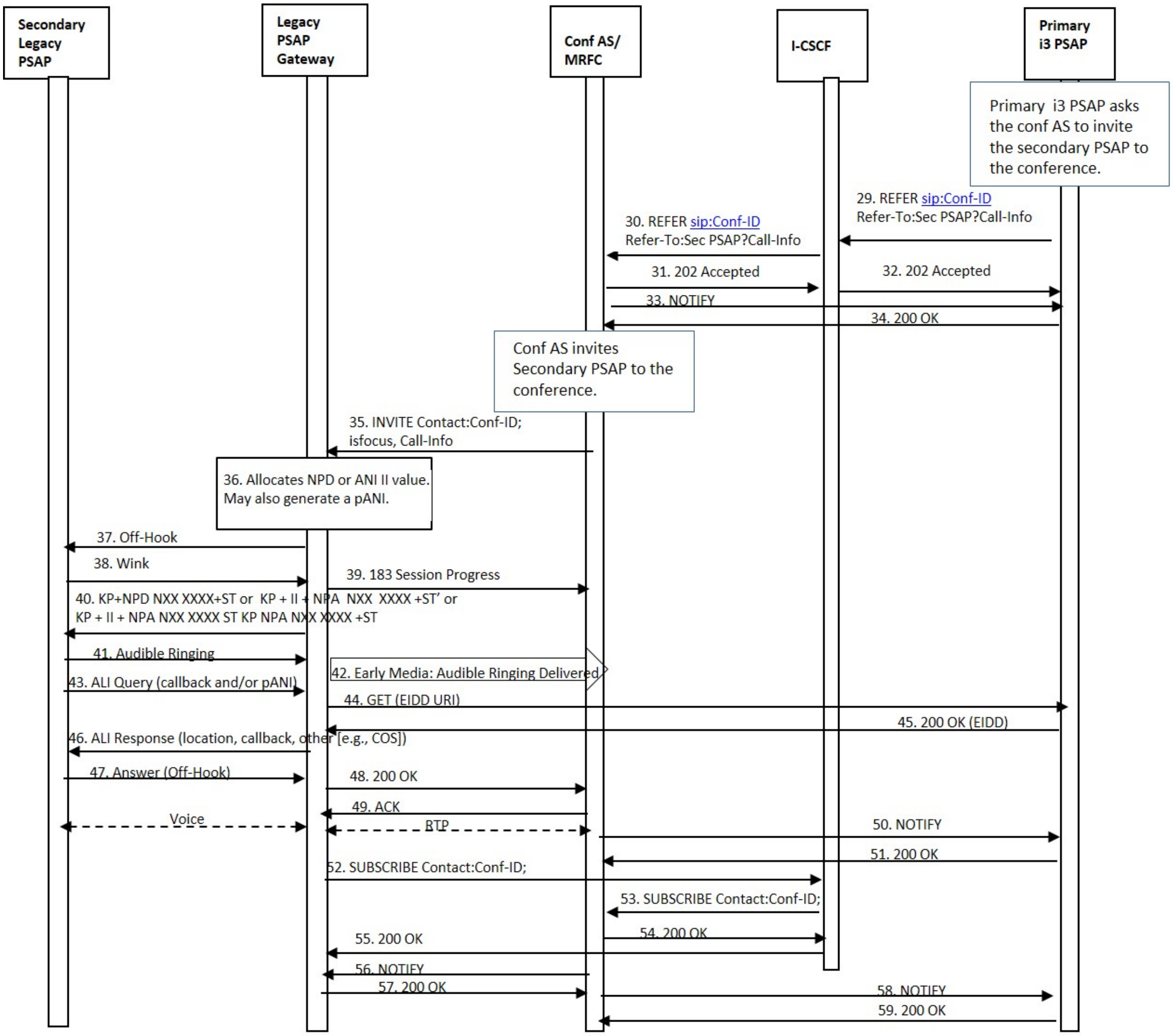

Figure 8-22: i3 PSAP Requests that a Secondary Legacy PSAP be Invited to the Conference

Step 29. The Primary i3 PSAP sends a REFER method I-CSCF (via an IBCF [not shown]).

Step 30. 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 Secondary (legacy) PSAP to the conference. The REFER method contains the Conf-ID and a Refer-To header that contains the URI of the Secondary (legacy) 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 31. The conferencing AS/MRFC returns a 202 Accepted message to the I-CSCF.

Step 32. The I-CSCF passes the 202 Accepted message (via an IBCF [not shown]) to the Primary i3 PSAP.

Step 33. The conferencing AS/MRFC then returns a NOTIFY message (via an IBCF [not shown]), indicating that subscription state of the REFER request (i.e., active).

Step 34. The Primary i3 PSAP returns a 200 OK message to the conferencing AS/MRFC (via an IBCF [not shown]) in response to the NOTIFY message.

Step 35. The conferencing AS/MRFC invites the Secondary (legacy) PSAP to the conference by sending an INVITE method (via a Transit Function/IBCF [not shown]) containing the Conf-ID and Contact header that contains the conference URI and the isfocus feature parameter to the LPG. The INVITE also contains the Call-Info header field containing a reference URI that points to the EIDD data structure and a purpose parameter of “eidd”. 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.

Step 36. The LPG determines, based on provisioning, whether the transfer-to PSAP supports a Traditional MF or Enhanced MF interface. Depending on the type of interface supported by the PSAP, the LPG may generate a pANI and will assign an appropriate NPD or ANI II value to the call, following the procedures specified in Section 7.2.2 of NENA-STA-010.2 [Ref 27].

Step 37. The LPG generates an off-hook signal toward the legacy PSAP.

Step 38. The legacy PSAP returns a wink signal back to the LPG.

Step 39. The LPG generates a 183 Session Progress message and sends it to the conferencing AS/MRFC (via the IBCF/Transit Function [not shown]).

Step 40. The LPG delivers the call to the legacy PSAP, mapping the SIP signaling from the incoming INVITE message to the outgoing Traditional or Enhanced MF signaling sequences, as appropriate for the legacy PSAP.

Step 41. Audible ringing is returned by the legacy PSAP to the LPG.

Step 42. Audible ringing is passed by the LPG to the conferencing AS/MRFC.

Step 43. The legacy PSAP sends a location query to the LPG using a legacy ALI protocol.

Step 44. The LPG queries the Primary i3 PSAP for the EIDD by including the URI provided in the Call-Info header in Step 32 in a GET request.

Step 45. The Primary PSAP returns the EIDD to the LPG.

Step 46. The LPG returns an ALI response to the legacy PSAP that includes the initial dispatch location information, a callback number and other information (e.g., class of service), as appropriate for the interface.

Step 47. When the PSAP answers the call, it returns an off-hook signal to the LPG.

Step 48. The LPG accepts the invitation to the conference by returning a 200 OK message to the conferencing AS/MRFC (via the IBCF/Transit Function [not shown]).

Step 49. The conferencing AS/MRFC acknowledges receipt of the 200 OK message by returning an ACK.

A media session is established between the Secondary (legacy) PSAP and the conferencing AS/MRFC.

Step 50. The conferencing AS/MRFC returns 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 51. The Primary i3 PSAP responds to the NOTIFY message by returning a 200 OK message.

Step 52. The LPG subscribes to the conference associated with the Conf-ID provided in the INVITE message from the conferencing AS/MRFC by sending a SUBSCRIBE message to the I-CSCF.

Step 53. The I-CSCF passes the SUBSCRIBE message to the conferencing AS/MRFC (via the IBCF [not shown]).

Step 54. The conferencing AS/MRFC acknowledges the subscription request by sending a 200 OK message back to the I-CSCF.

Step 55. The I-CSCF passes the 200 OK message to the LPG (via the IBCF [not shown]).

Step 56. The conferencing AS/MRFC then returns a NOTIFY message to the LPG (via the IBCF [not shown]) to provide subscription status information.

Step 57. The LPG responds by returning a 200 OK message.

Step 58. The conferencing AS/MRFC sends a NOTIFY message to the Primary i3 PSAP (via an IBCF [not shown]), providing updated status for the subscription associated with the REFER request.

Step 59. The Primary i3 PSAP responds to the NOTIFY message by returning a 200 OK message.

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

8.8.1.1.4 Primary i3 PSAP Disconnects from the Conference

Once the Primary i3 PSAP determines that the transfer can be completed, the Primary i3 PSAP disconnects from the conference, as illustrated in Figure 8-23 and Figure 8-24.

8.8.1.1.4.1 Secondary PSAP is an i3 PSAP

This call flow illustrates a scenario when the Secondary PSAP is an i3 PSAP.

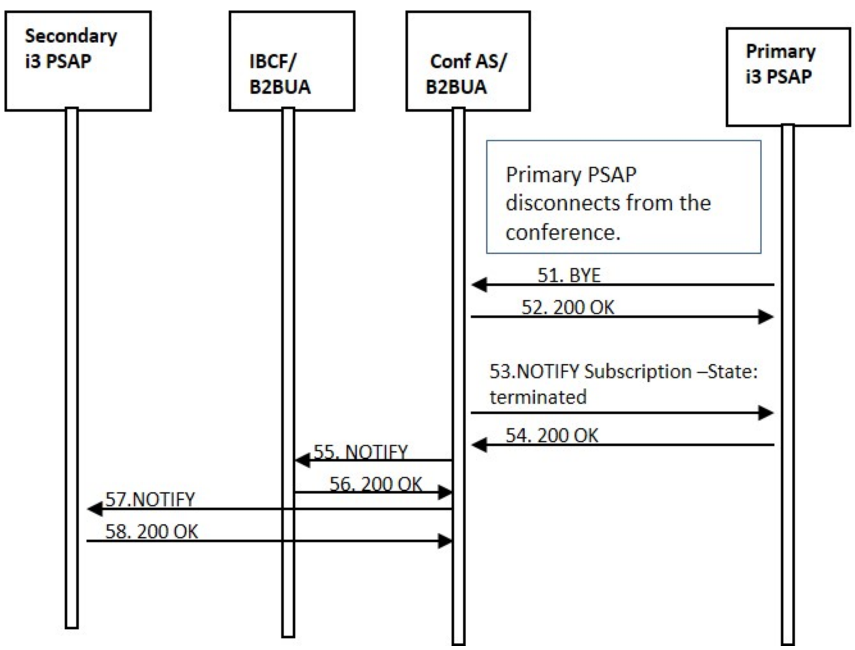

Figure 8-23: Primary i3 PSAP Disconnects from the Conference – Secondary PSAP is an I3 PSAP

Step 51. Upon determining that the emergency call transfer should be completed, the Primary PSAP disconnects from the call by sending a BYE message to the conferencing AS/MRFC (via an IBCF [not shown]).

Step 52. The conferencing AS/MRFS responds by returning a 200 OK message.

Step 53. The conferencing AS/MRFC then returns a NOTIFY message to the Primary i3 PSAP (via an IBCF [not shown]) indicating that the subscription to the conference has been terminated.

Step 54. The Primary i3 PSAP returns a 200 OK message in response to the NOTIFY message.

Step 55. The conferencing AS/MRFC then returns a NOTIFY message to the IBCF/B2BUA indicating that there has been a change to the subscription state.

Step 56. The IBCF/B2BUA returns a 200 OK message in response to the NOTIFY message.

Step 57. The conferencing AS/MRFC then returns a NOTIFY message to the Secondary i3 PSAP (via the IBCF [not shown]) indicating that there has been a change to the subscription state.

Step 58. The Secondary i3 PSAP returns a 200 OK message in response to the NOTIFY message.

8.8.1.1.4.2 Secondary PSAP is a Legacy PSAP

This call flow illustrates a scenario when the Secondary PSAP is a legacy PSAP.

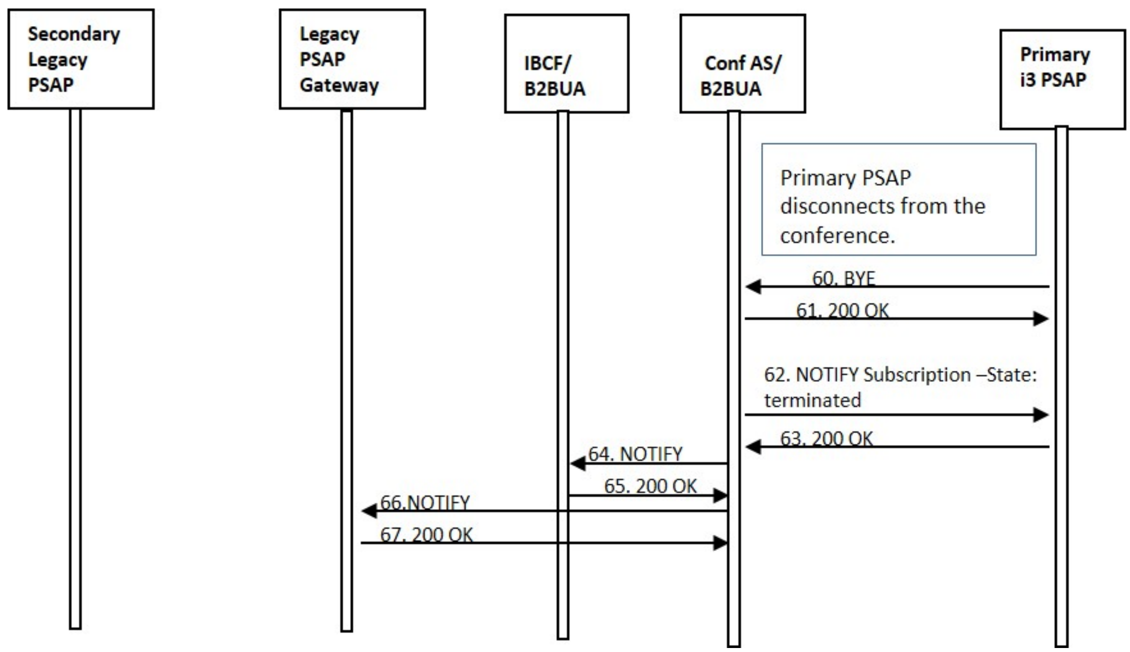

Figure 8-24: Primary i3 PSAP Disconnects from the Conference – Secondary PSAP is a Legacy PSAP

Step 60. Upon determining that the emergency call transfer should be completed, the Primary PSAP disconnects from the call by sending a BYE message to the conferencing AS/MRFC (via the IBCF [not shown]).

Step 61. The conferencing AS/MRFS responds by returning a 200 OK message.

Step 62. The conferencing AS/MRFC then returns a NOTIFY message to the Primary i3 PSAP (via the IBCF [not shown]) indicating that the subscription to the conference has been terminated.

Step 63. The Primary i3 PSAP returns a 200 OK message in response to the NOTIFY message.

Step 64. The conferencing AS/MRFC then returns a NOTIFY message to the IBCF/B2BUA indicating that there has been a change to the subscription state.

Step 65. The IBCF/B2BUA returns a 200 OK message in response to the NOTIFY message.

Step 66. The conferencing AS/MRFC then returns a NOTIFY message to the LPG (via the IBCF [not shown]) indicating that there has been a change to the subscription state.

Step 67. The LPG returns a 200 OK message in response to the NOTIFY message.

8.8.1.1.5 Secondary PSAP Completes the Transfer

The Secondary PSAP then completes the transfer as illustrated in Figure 8-25 and Figure 8-26. Note that the connection between the caller and the IBCF/B2BUA is unaffected by the completion of the transfer by the Secondary PSAP. The following flows also illustrate termination of the emergency call initiated by the Secondary PSAP.

8.8.1.1.5.1 Secondary PSAP is an i3 PSAP

This call flow illustrates a scenario when the Secondary PSAP is an i3 PSAP.

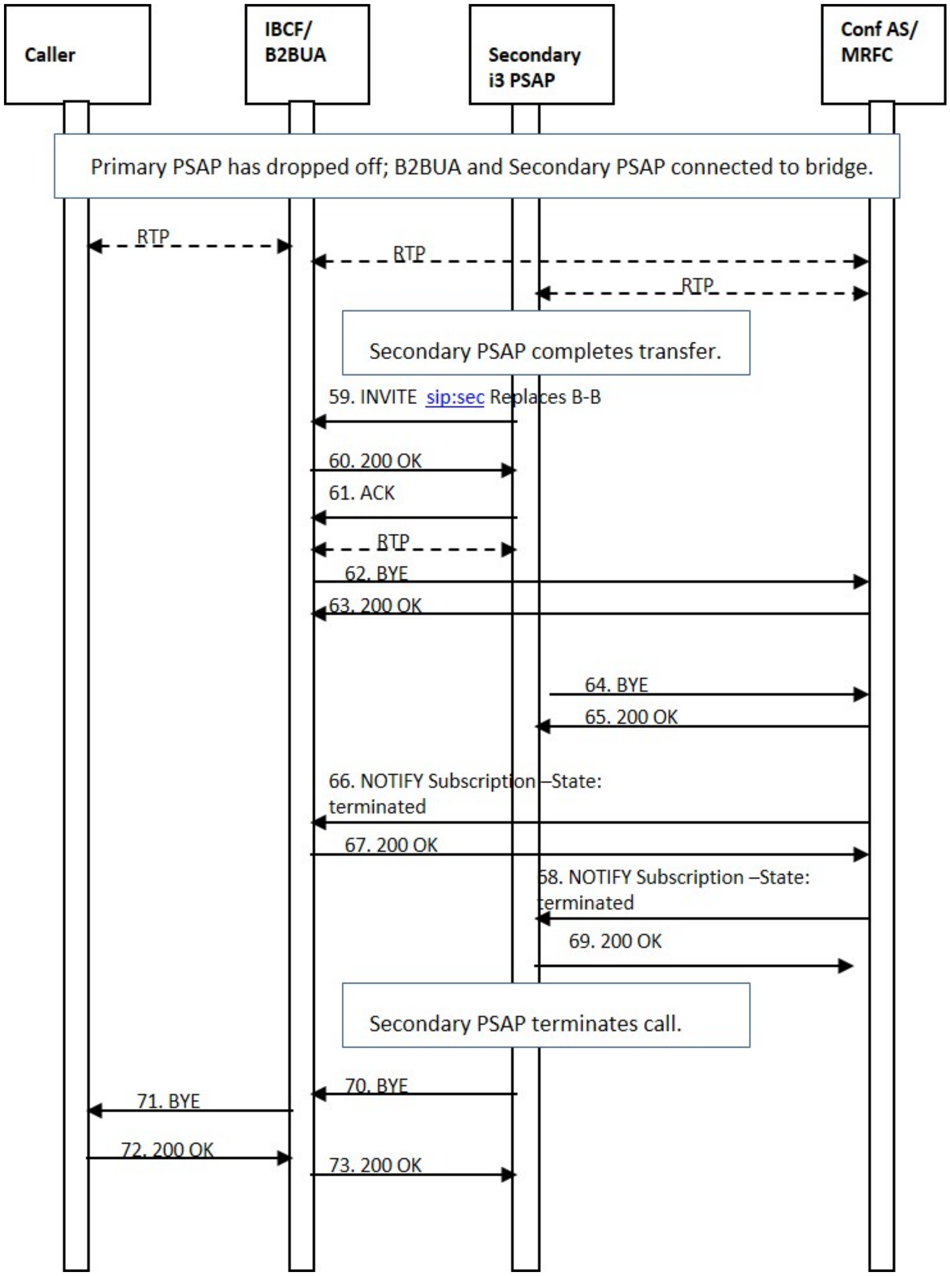

Figure 8-25: Secondary i3 PSAP Completes the Transfer and Terminates the Call

Step 59. The Secondary i3 PSAP completes the transfer by sending a SIP INVITE message to the IBCF/B2BUA requesting that it replaces its connection to the conferencing AS/MRFC with a direct connection to the Secondary i3 PSAP. (The Secondary i3 PSAP learns the URI of the IBCF/B2BUA from the ‘entity’ attribute, and the call-id from the <call-info> child element of the <endpoint> portion of the <user> sub-element in the <conference-info> with the NOTIFY message from the bridge. See RFC 4575 for further details.)

Step 60. The IBCF/B2BUA responds by returning a 200 OK message.

Step 61. The Secondary i3 PSAP returns an ACK in response to the 200 OK message.

At this point, a session is established between the IBCF/B2BUA and the Secondary i3 PSAP. The media session between the IBCF/B2BUA and the conferencing AS/MRFC also still exists at this time.

Step 62. The IBCF/B2BUA then sends a BYE to the conferencing AS/MRFC to terminate the session.

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

Step 63. The conferencing AS/MRFC responds by returning a 200 OK message.

At this time the session between the B2BUA and the conferencing AS/MRFC is terminated.

Step 64. The Secondary i3PSAP also terminates its session with the conferencing AS/MRFC by sending a BYE message (via an IBCF) to the conferencing AS/MRFC.

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

Step 65. The conferencing AS/MRFC responds by sending a 200 OK message to the Secondary i3 PSAP.

At this point, the session between the Secondary i3 PSAP and the conferencing AS/MRFC is terminated.

Step 66. The conferencing AS/MRFC then returns a NOTIFY message to the IBCF/B2BUA indicating that the subscription to the conference has been terminated.

Step 67. The IBCF/B2BUA responds with a 200 OK message.

Step 68. The conferencing AS/MRFC then returns a NOTIFY message to the Secondary i3 PSAP (via an IBCF [not shown]) indicating that the subscription to the conference has been terminated.

Step 69. The Secondary i3 PSAP responds with a 200 OK message.

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

Step 70. The Secondary i3 PSAP determines that the call should be terminated and sends a BYE message (via an IBCF [not shown]) to the IBCF/B2BUA.

Step 71. The IBCF/B2BUA sends a BYE message to the calling device to terminate the session.

Step 72. The calling device sends a 200 OK message to the B2BUA in response to the BYE.

Step 73. The IBCF/B2BUA sends a 200 OK message to the Secondary i3 PSAP (via an IBCF [not shown]) in response to receiving the 200 OK message from the calling device.

At this point the emergency session is terminated.

8.8.1.1.5.2 Secondary PSAP is a Legacy PSAP

This call flow illustrates a scenario when the Secondary PSAP is a legacy PSAP.

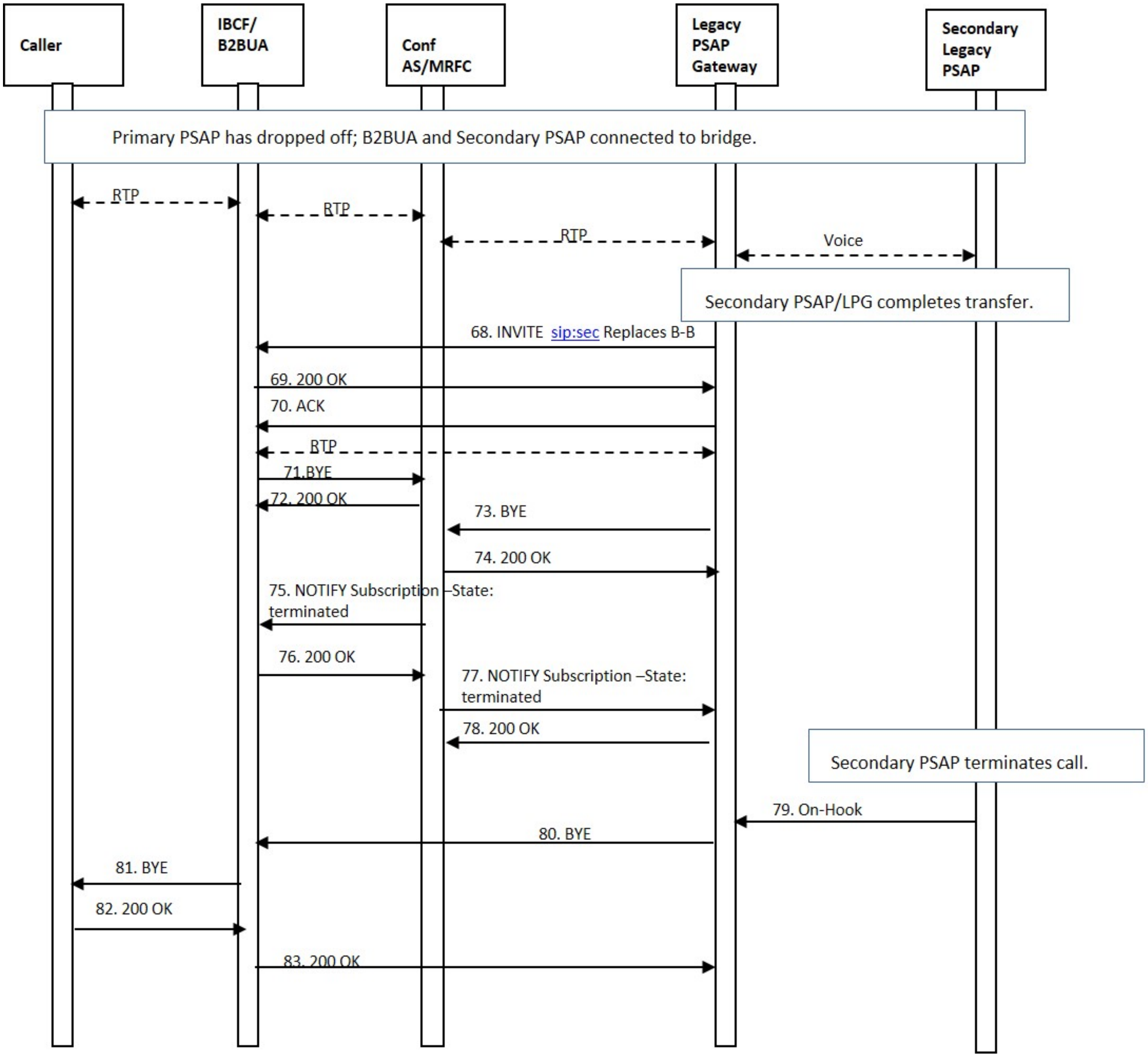

Figure 8-26: Secondary Legacy PSAP/LPG Completes the Transfer and Terminates the Call

Step 68. The LPG completes the transfer by sending a SIP INVITE message to the IBCF/B2BUA requesting that it replaces its connection to the conferencing AS/MRFC with a direct connection to the LPG. (The LPG learns the URI of the IBCF/B2BUA from the 'entity' attribute, and the call-id from the <call-info> child element of the <endpoint> portion of the <user> sub-element in the <conference-info> within the NOTIFY message from the bridge. See RFC 4575 for further details.)

Step 69. The IBCF/B2BUA responds by returning a 200 OK message.

Step 70. The LPG returns an ACK in response to the 200 OK message.

At this point, a session is established between the IBCF/B2BUA and the Secondary legacy PSAP via the LPG. The media session between the IBCF/B2BUA and the conferencing AS/MRFC also still exists at this time.

Step 71. The IBCF/B2BUA then sends a BYE to the conferencing AS/MRFC to terminate the session.

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

Step 72. The conferencing AS/MRFC responds by returning a 200 OK message.

At this time the session between the IBCF/B2BUA and the conferencing AS/MRFC is terminated.

Step 73. The LPG also terminates its session with the conferencing AS/MRFC by sending a BYE message to the conferencing AS/MRFC (via an IBCF [not shown]).

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

Step 74. The conferencing AS/MRFC responds by sending a 200 OK message to the LPG (via an IBCF [not shown]).

At this point, the session between the LPG and the conferencing AS/MRFC is terminated.

Step 75. The conferencing AS/MRFC then returns a NOTIFY message to the IBCF/B2BUA indicating that the subscription to the conference has been terminated.

Step 76. The IBCF/B2BUA responds with a 200 OK message.

Step 77. The conferencing AS/MRFC then returns a NOTIFY message to the LPG (via an IBCF [not shown]) indicating that the subscription to the conference has been terminated.

Step 78. The LPG responds with a 200 OK message.

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

Step 79. The Secondary (legacy) PSAP determines that the call should be terminated and sends an on-hook indication to the LPG.

Step 80. The LPG maps the on-hook indication to a SIP BYE message and sends the SIP BYE message (via an IBCF [not shown]) to the IBCF/B2BUA.

Step 81. The IBCF/B2BUA sends a BYE message to the calling device to terminate the session.

Step 82. The calling device sends a 200 OK message to the B2BUA in response to the BYE.

Step 83. The IBCF/B2BUA sends a 200 OK message to the LPG (via an IBCF [not shown]) in response to receiving the 200 OK message from the calling device.

At this point the emergency session is terminated.

8.8.1.2 Signaling/Media Anchoring at Egress Point

This Section illustrates the call flow where the header replacement and media anchoring happens at the PSAP-facing IBCF. The E-CSCF in the emergency network will route the call to an IBCF that would be used as B2BUA for media anchoring. The role played by the originating network-facing IBCF can be either a B2BUA or Proxy.

The initial call is established and is shown as call #1 between IBCFs, and call #1a between IBCF#2 and Primary PSAP. The PSAP (referred to as Primary PSAP and is shown as Primary PSAP) transfers the emergency call to a Secondary PSAP. Before the transfer, the Primary PSAP establishes a conference call between the emergency call originator and the Secondary PSAP, and then drops out of the call to do the transfer. The overall process is executed in multiple steps.

8.8.1.2.1 Primary PSAP Requests the AS/MRFC to the Conference

In the first step, the Primary PSAP invokes the conference. The flow assumes that an emergency call is already established between the calling party and the Primary PSAP.

NOTE: IBCF#2 and IBCF#3 may actually be the same physical IBCF but are shown separately to illustrate that it does not necessarily need to be the same.

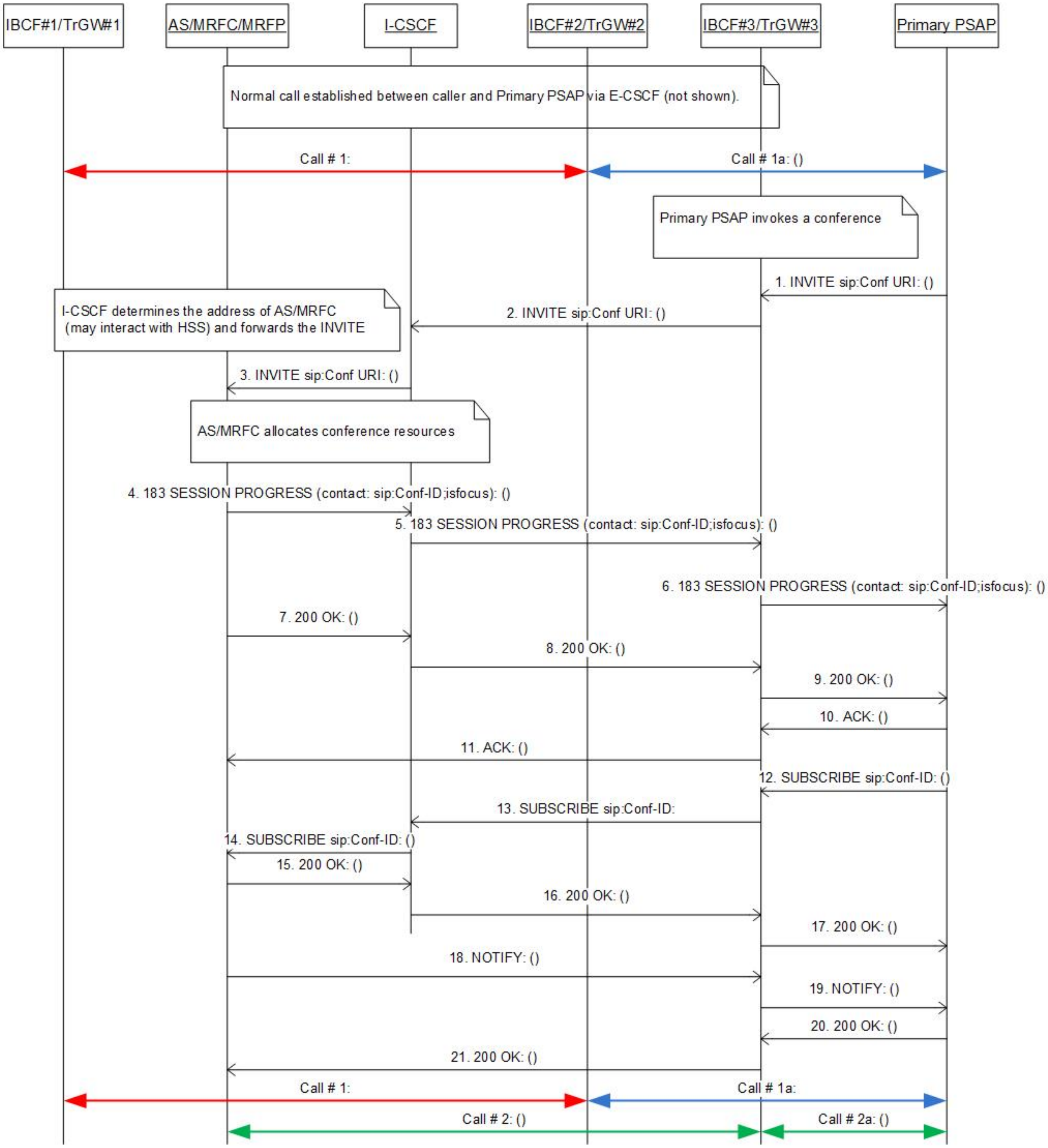

Figure 8-27: Primary i3 PSAP Invokes the Conference

Step 1. The Primary PSAP sends an INVITE with conference URI as the Request URI to the IBCF#3.

Step 2. The IBCF#3 forwards the INVITE to the I-CSCF.

Step 3. The I-CSCF determines the address of the conferencing AS/MRFC and forwards the INVITE to AS/MRFC.

NOTE: I-CSCF does not add itself to the Record-Route header.

Step 4. 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. The conferencing AS/MRFC responds to the INVITE by returning a 183 SESSION PROGRESS to the I-CSCF. The Contact header contains the conference URI for the conference allocated at the AS/MRFC and the “isfocus” feature parameter indicating a conference call.

Step 5. The I-CSCF forwards the 183 SESSION PROGRESS to the IBCF#3.

Step 6. The IBCF#3 forwards the 183 SESSION PROGRESS to the Primary PSAP.

Step 7. The AS/MRFC sends a 200 OK to the I-CSCF in response to the INVITE message.

Step 8. The I-CSCF forwards the 200 OK to the IBCF#3.

Step 9. The IBCF#3 forwards the 200 OK to the Primary PSAP.

Step 10. The Primary PSAP returns an ACK acknowledging the receipt of 200 OK to the IBCF#3.

Step 11. The IBCF#3 forwards the ACK to the AS/MRFC.

At this point the media session is established between MRFP and the Primary PSAP. (The actual media leg between MRFP and IBCF#3 is denoted as call #2, and the media between IBCF#3 and the Primary PSAP is denoted as call #2a. The UE is still connected to the Primary PSAP as call #1.)

Step 12. The Primary PSAP sends a SUBSCRIBE to AS/MRFC to stay informed regarding the status of the conference call to the IBCF#3.

Step 13. The IBCF#3 forwards the SUBSCRIBE to the I-CSCF.

Step 14. The I-CSCF forwards the SUBSCRIBE to the AS/MRFC.

Step 15. The AS/MRFC sends a 200 OK back to the I-CSCF.

Step 16. The I-CSCF forwards the 200 OK to the IBCF#3.

Step 17. The IBCF#3 forwards the 200 OK to the Primary PSAP.

Step 18. The AS/MRFC sends a NOTIFY to the Primary PSAP via IBCF#3.

Step 19. The IBCF#3 forwards the NOTIFY to the Primary PSAP.

Step 20. The Primary PSAP sends a 200 OK back to the AS/MRFC in response to NOTIFY via IBCF#3.

Step 21. The IBCF#3 forwards the 200 OK to the AS/MRFC.

8.8.1.2.2 Primary PSAP Requests Conferencing AS Invite IBCF#2/B2BUA to Conference

This call flow shows the bridging of call #1 (original call) through the conference to the call #2.

NOTE: IBCF#2 and IBCF#3 may actually be the same physical IBCF but are shown separately to illustrate that it does not necessarily need to be the same.

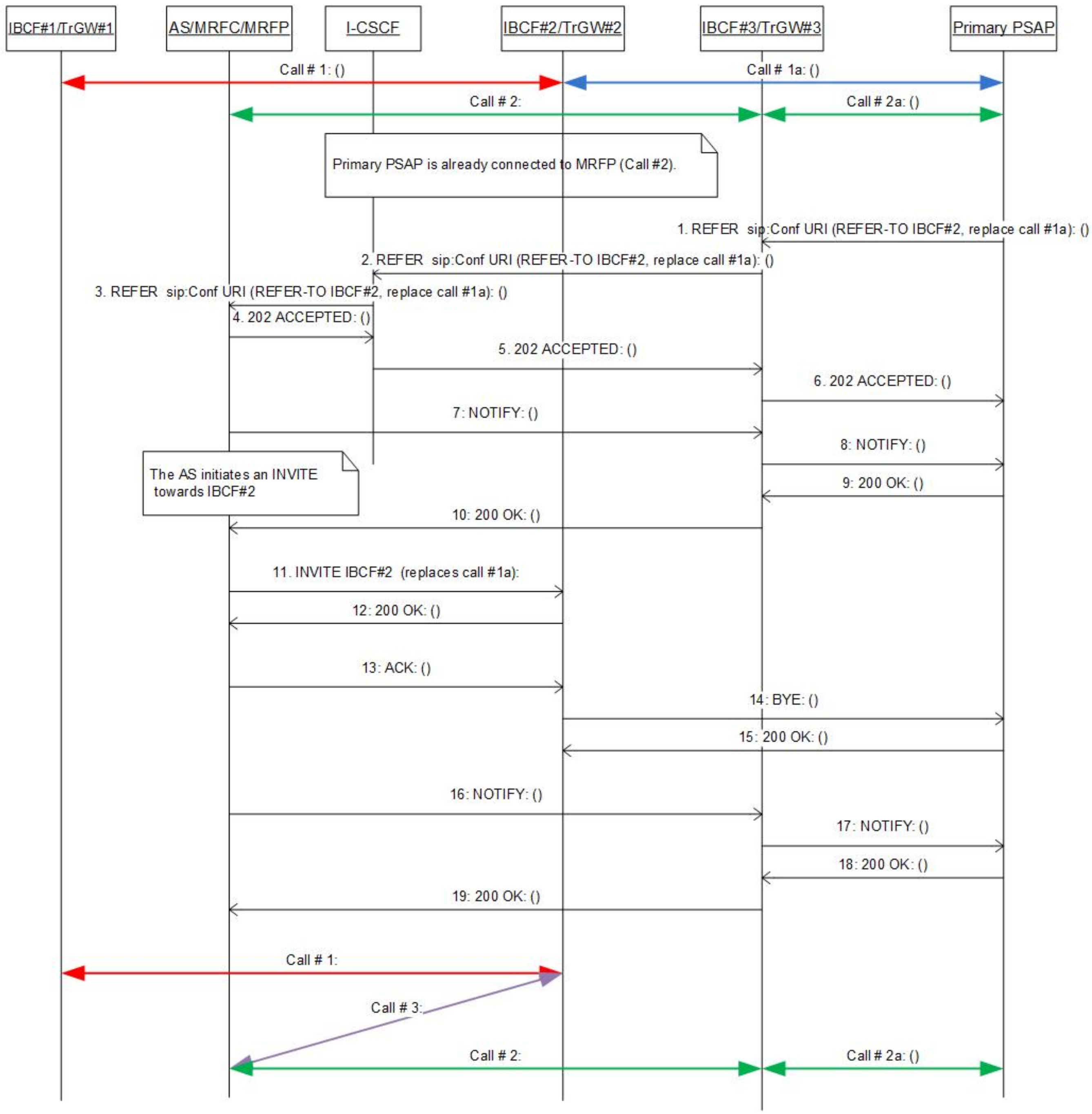

Figure 8-28: Application Server (AS) Bridges Call #1 and Call #2 via IBCF#2

Step 1. In order to bridge the original call with call #2 established with AS/MRFC, call #1a needs to be redirected to MRFP. The Primary PSAP sends a REFER to the IBCF#3 (with Request URI containing the Conference URI) with Refer-To header pointing to IBCF#2 and with Replaces identifying call #1a.

NOTE: REFER could go to a new IBCF instead of IBCF#3.

Step 2. The IBCF#3 forwards the REFER to the I-CSCF.

Step 3. The I-CSCF forwards the REFER to AS/MRFC. I-CSCF does not add itself to the Record-Route header.

Step 4. The AS/MRFC returns a 202 Accepted towards the Primary PSAP via I-CSCF.

Step 5. The I-CSCF forwards the 202 Accepted to the IBCF#3.

Step 6. The IBCF#3 forwards the 202 Accepted to the Primary PSAP.

Step 7. The AS/MRFC sends a NOTIFY towards the Primary PSAP via IBCF#3.

Step 8. The IBCF#3 forwards the NOTIFY to the Primary PSAP.

Step 9. The Primary PSAP responds back to the NOTIFY with a 200 OK.

Step 10. The IBCF#3 forwards the 200 OK to the AS/MRFC.

Step 11. The AS/MRFC initiates an INVITE towards IBCF#2; the Replaces in the INVITE identifies call #1a.

Step 12. The IBCF#2 sends a 200 OK back to the AS/MRFC.

Step 13. The AS/MRFC acknowledges the receipt of 200 OK by sending an ACK back to the IBCF#2.

Step 14. The IBCF#2 releases the connection for call #1a by sending a BYE towards the Primary PSAP.

At this point, IBCF#2 switches the media from call #1a to call #3.

Step 15. The Primary PSAP sends a 200 OK back to the IBCF#2.

At this point, the Primary PSAP switches the media from call #1a to call #2.

Step 16. The conference AS/MRFC sends a NOTIFY to the Primary PSAP via IBCF#3 to indicate that the session setup to IBCF#2 (as requested in the REFER) is completed.

Step 17. The IBCF#3 forwards the NOTIFY to the Primary PSAP.

Step 18. The Primary PSAP sends a 200 OK back to the AS/MRFC via IBCF#3.

Step 19. The IBCF#3 forwards the 200 OK to the AS/MRFC.

At this point the original call (i.e., call #1) is connected to the new call #3 at IBCF#2/TrGW#2. Call #2 was created between Primary PSAP and AS/MRFC/MRFP via IBCF#3/TrGW#3. Finally call #1a between IBCF#2 and Primary PSAP is released.

8.8.1.2.3 Primary PSAP Requests that the Conferencing AS Invite the Secondary PSAP to the Conference

At this point the PSAP is communicating to the originating party through the conference. Then the Primary PSAP initiates a call to the Secondary PSAP through the AS/MRFC. When Primary 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 the Primary PSAP requests an AS/MRFC to invite the Secondary PSAP to the call, it must include all necessary call data for the call in the request.

8.8.1.2.3.1 Secondary PSAP is an i3 PSAP

This call flow illustrates a scenario when the Secondary PSAP is an i3 PSAP.

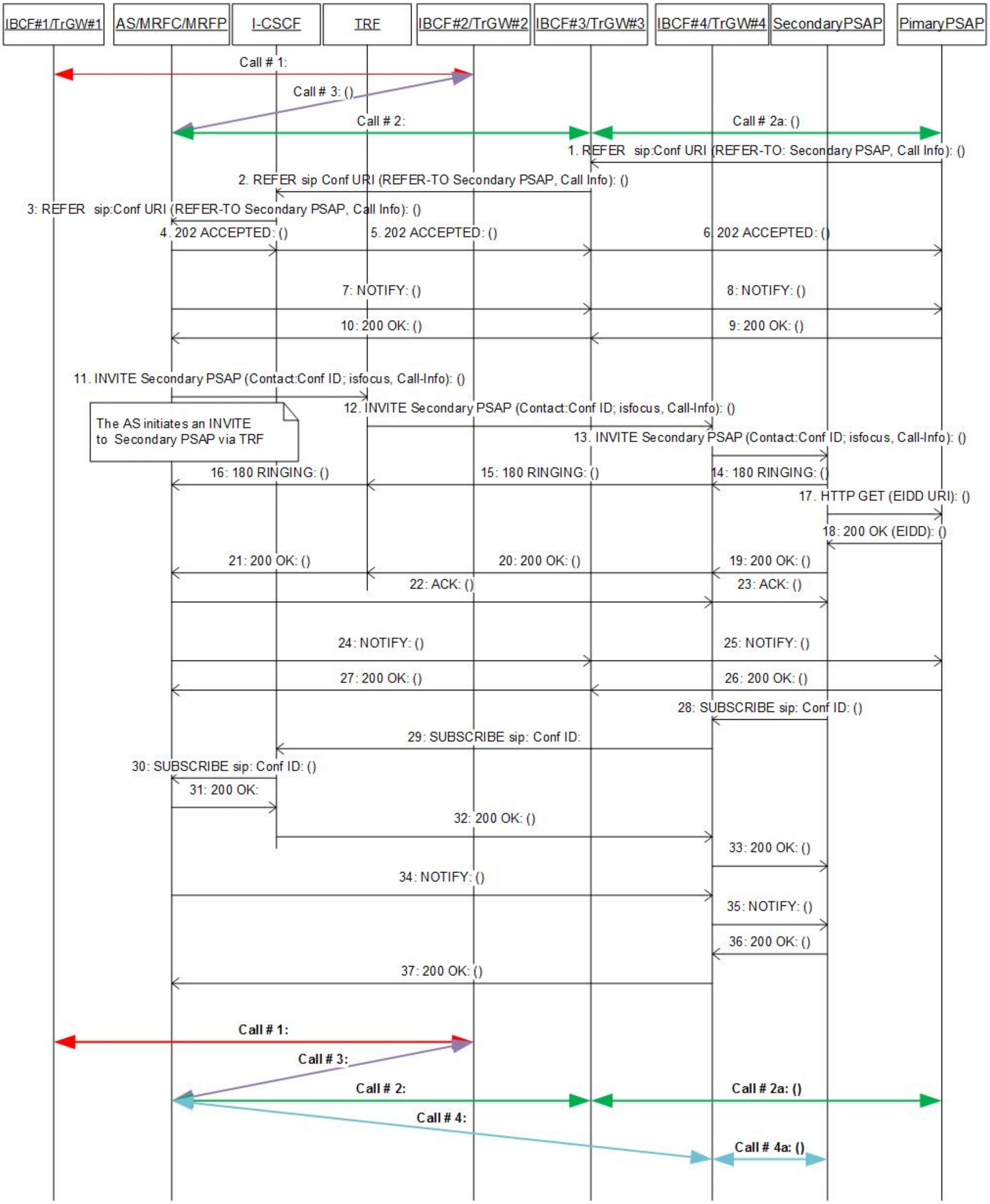

Figure 8-29: Application Server (AS) Invites Secondary i3 PSAP to Conference

Step 1. The Primary PSAP sends a REFER to the IBCF#3 (with Request URI containing the Conference URI) with Refer-To header pointing to Secondary PSAP (shown as Secondary PSAP). The REFER also contains an escaped Call-Info header containing a reference URI that points to the EIDD data structure and a purpose parameter of “eidd”.

Step 2. The IBCF#3 forwards the REFER to the I-CSCF to be forwarded to the AS/MRFC.

Step 3. The I-CSCF forwards the REFER to the AS/MRFC.

Step 4. The AS/MRFC sends a 202 ACCEPTED back to the Primary PSAP via I-CSCF.

Step 5. The I-CSCF forwards the 202 ACCEPTED towards the IBCF#3.

Step 6. The IBCF#3 forwards the 202 ACCEPTED towards the Primary PSAP.

Step 7. The AS/MRFC sends a NOTIFY towards the Primary PSAP via IBCF#3.

Step 8. The IBCF#3 forwards the NOTIFY to the Primary PSAP.

Step 9. The Primary PSAP sends a 200 OK back to the AS/MRFC via IBCF#3.

Step 10. The IBCF#3 forwards the 200 OK to the AS/MRFC.

Step 11. The AS/MRFC initiates a call establishment towards the Secondary PSAP by sending an INVITE via TRF including the conference URI, Call-Info header and isfocus feature parameter.

Step 12. The TRF forwards the INVITE to IBCF#4 for delivery to the Secondary PSAP.

Step 13. The IBCF#4 forwards the INVITE to the Secondary PSAP.

Step 14. The Secondary PSAP UA responds by returning a 180 RINGING to the AS/MRFC via IBCF#4.

Step 15. The IBCF#4 forwards the 180 RINGING to the TRF.

Step 16. The TRF forwards the 180 RINGING to the AS/MRFC.

Step 17. The Secondary PSAP sends an HTTP GET (EIDD) towards Primary PSAP to get the EIDD from the Primary PSAP.

Step 18. The Primary PSAP responds back with a 200 OK containing the EIDD.

Step 19. The Secondary PSAP accepts the invitation by returning a 200 OK back to AS/MRFC via IBCF#4.

Step 20. The IBCF#4 forwards the 200 OK to the TRF.

Step 21. The TRF forwards the 200 OK to the AS/MRFC.

Step 22. The AS/MRFC acknowledges the 200 OK by sending an ACK back to the Secondary PSAP via IBCF#4.

Step 23. The IBCF#4 forwards the ACK to the Secondary PSAP.

At this point a media path has been setup between the MRFP and the Secondary PSAP denoted by call #4 in the call flow.

Step 24. The AS/MRFC sends a NOTIFY towards the Primary PSAP via IBCF#3 to indicate that the session setup to the Secondary PSAP (as requested in the REFER) is completed.

Step 25. The IBCF#3 forwards the NOTIFY to the Primary PSAP.

Step 26. The Primary PSAP sends a 200 OK back to the AS/MRFC.

Step 27. The IBCF#3 forwards the 200 OK to the AS/MRFC.

At this point the original call (call #1) is connected to the conference (via call #3). The Primary PSAP is bridged in via call #2 and the Secondary PSAP is bridged in via call #4 as shown in the figure.

Step 28. The Secondary PSAP sends a SUBSCRIBE towards AS/MRFC via IBCF#4 to subscribe to the conference events.

Step 29. The IBCF#4 forwards the SUBSCRIBE to the I-CSCF.

Step 30. The I-CSCF forwards the SUBSCRIBE to the AS/MRFC.

Step 31. The AS/MRFC sends a 200 OK in response to the SUBSCRIBE via the I-CSCF.

Step 32. The I-CSCF forwards the 200 OK to IBCF#4.

Step 33. The IBCF#4 forwards the 200 OK to the Secondary PSAP.

Step 34. The AS/MRFC sends a NOTIFY to the Secondary PSAP via IBCF#4.

Step 35. The IBCF#4 forwards the NOTIFY to the Secondary PSAP.

Step 36. The Secondary PSAP sends a 200 OK in response to the NOTIFY via IBCF#4 to the AS/MRFC.

Step 37. The IBCF#4 forwards the 200 OK to the AS/MRFC.

8.8.1.2.3.2 Secondary PSAP is a Legacy PSAP

This call flow illustrates a scenario when the Secondary PSAP is a legacy PSAP.

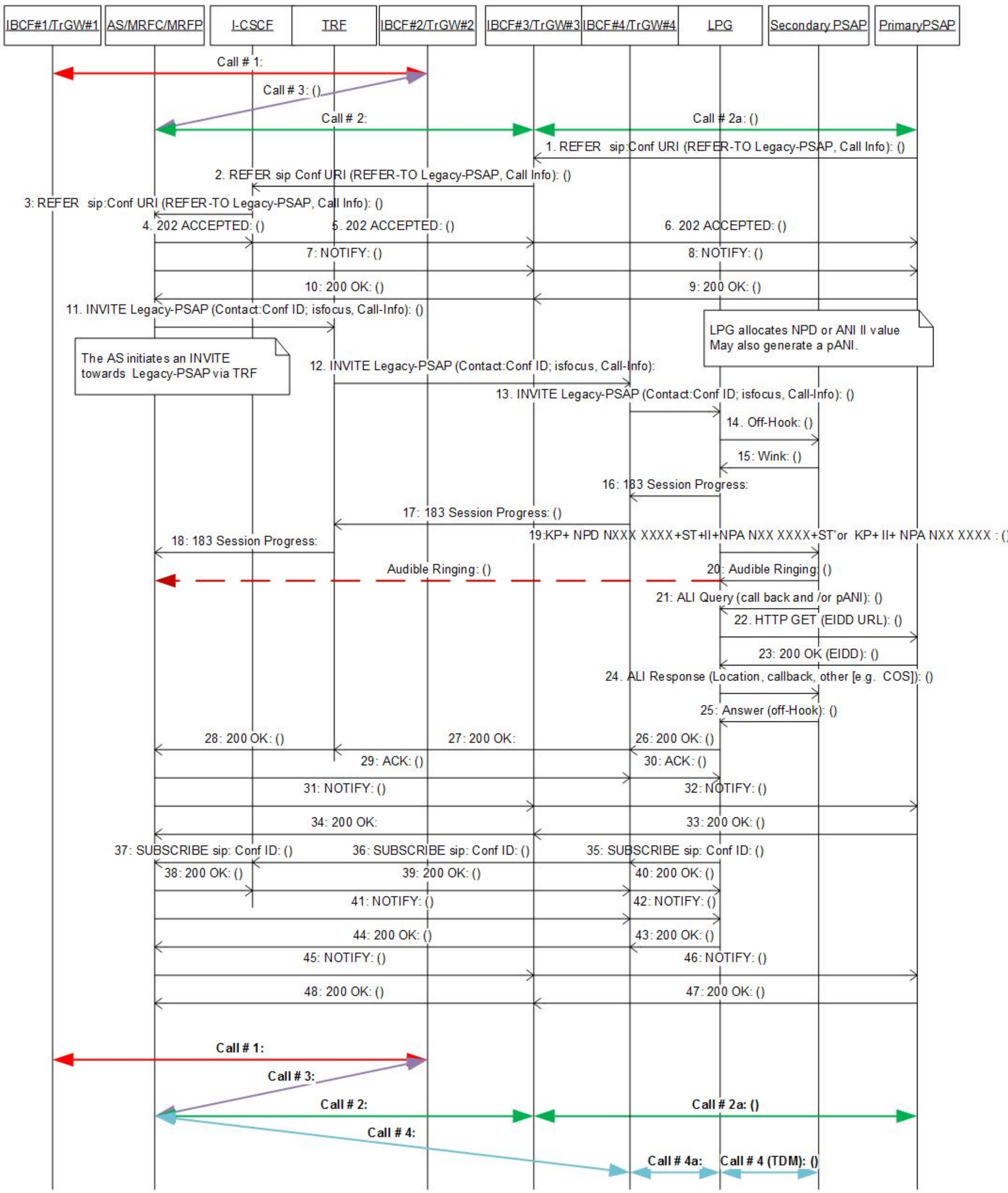

Figure 8-30: Application Server (AS) Invites Secondary Legacy PSAP to Conference

Step 1. The Primary PSAP sends a REFER to the IBCF#3 (with Request URI containing the Conference URI) with Refer-To header pointing to Secondary PSAP (shown as Secondary

PSAP). The REFER also contains an escaped Call-Info header containing a reference URI that points to the EIDD data structure and a purpose parameter of “eidd”.

Step 2. The IBCF#3 forwards the REFER to the I-CSCF to be forwarded to the AS/MRFC.

Step 3. The I-CSCF forwards the REFER to the AS/MRFC.

Step 4. The AS/MRFC sends a 202 ACCEPTED back to the Primary PSAP via I-CSCF.

Step 5. The I-CSCF forwards the 202 ACCEPTED towards the IBCF#3.

Step 6. The IBCF#3 forwards the 202 ACCEPTED towards the Primary PSAP.

Step 7. The AS/MRFC sends a NOTIFY towards the Primary PSAP via IBCF#3.

Step 8. The IBCF#3 forwards the NOTIFY to the Primary PSAP.

Step 9. The Primary PSAP sends a 200 OK back to the AS/MRFC via IBCF#3.

Step 10. The IBCF#3 forwards the 200 OK to the AS/MRFC.

Step 11. The AS/MRFC initiates a call establishment towards Secondary PSAP by sending an INVITE towards Secondary PSAP via TRF including the conference URI, Call-Info header, and isfocus feature parameter.

Step 12. The TRF forwards the INVITE to the IBCF#4 for delivery to Secondary PSAP.

Step 13. The IBCF#4 forwards the INVITE to the LPG. The LPG determines, based on provisioning, whether the transfer-to PSAP supports a Traditional MF or Enhanced MF interface. Depending on the type of interface supported by the PSAP, the LPG may generate a pANI and will assign an appropriate NPD or ANI II value to the call, following the procedures specified in Section 7.2.2 of NENA-STA-010.2 [Ref 27].

Step 14. The LPG generates an off-hook signal toward the legacy PSAP.

Step 15. The legacy PSAP returns a wink signal back to the LPG.

Step 16. The LPG generates a 183 Session Progress message and sends it to the conferencing AS/MRFC via the IBCF#4.

Step 17. The IBCF#4 forwards the 183 Session Progress message to the TRF.

Step 18. The TRF forwards the 183 Session Progress message to the AS/MRFC.

Step 19. The LPG delivers the call to the legacy PSAP, mapping the SIP signaling from the incoming INVITE message to the outgoing Traditional or Enhanced MF signaling sequences, as needed for delivery to the legacy PSAP.

Step 20. The legacy PSAP returns with Audible ringing indication to the LPG. The LPG passes the Audible ringing indication to the AS/MRFC.

Step 21. The legacy PSAP sends a location query to the LPG using a legacy ALI protocol.

Step 22. The LPG queries the Primary i3 PSAP for the EIDD by including the URI provided in the Call-Info header in an outgoing GET request.

Step 23. The Primary PSAP returns the EIDD to the LPG in 200 OK.

Step 24. The LPG returns an ALI response to the legacy PSAP that includes the initial dispatch location information, a callback number, and other information (e.g., class of service), as appropriate for the interface.

Step 25. When the Secondary legacy PSAP answers the call, it returns an off-hook signal to the LPG.

Step 26. The LPG generates a 200 OK in response and sends it to the AS/MRFC via IBCF#4.

Step 27. The IBCF#4 forwards the 200 OK to the TRF.

Step 28. The TRF forwards the 200 OK to the AS/MRFC.

Step 29. The AS/MRFC sends an ACK back to the LPG via IBCF#4.

Step 30. The IBCF#4 forwards the ACK to the LPG.

Step 31. The AS/MRFC sends a NOTIFY towards the Primary PSAP via IBCF#3 to indicate that the session setup to Secondary PSAP (as requested in the REFER) is completed.

Step 32. The IBCF#3 forwards the NOTIFY to the Primary PSAP.

Step 33. The Primary PSAP sends a 200 OK back to the AS/MRFC via IBCF#3.

Step 34. The IBCF#3 forwards the 200 OK to the AS/MRFC. At this point the original call (call #1) is connected to the conference (via call #3). Primary PSAP is bridged in via call #2, and the Secondary PSAP is bridged in via call #4 as shown in the figure.

NOTE: The call #4 to the left of LPG is an RTP based call, while to right of LPG is a TDM based call.

Step 35. The LPG sends a SUBSCRIBE towards AS/MRFC to subscribe to the conference events.

NOTE: The SUBSCRIBE message could go through a different IBCF than IBCF #4.

Step 36. The IBCF#4 forwards the SUBSCRIBE to the I-CSCF.

Step 37. The I-CSCF forwards the SUBSCRIBE to the AS/MRFC.

Step 38. The AS/MRFC sends a 200 OK in response via I-CSCF.

Step 39. The I-CSCF forwards the 200 OK to the IBCF#4.

Step 40. The IBCF#4 forwards the 200 OK to the LPG.

Step 41. The AS/MRFC sends a NOTIFY to the Secondary PSAP via IBCF#4.

Step 42. The IBCF#4 forwards the NOTIFY to the LPG.

Step 43. The LPG sends a 200 OK in response to NOTIFY back towards AS/MRFC via IBCF#4.

Step 44. The IBCF#4 forwards the 200 OK to the AS/MRFC.

Step 45. The AS/MRFC sends a NOTIFY to the Primary PSAP via IBCF#3 providing an update on the conference events.

Step 46. The IBCF#3 forwards the NOTIFY to the Primary PSAP.

Step 47. The Primary PSAP sends 200 OK back to the AS/MRFC via IBCF#3 in response.

Step 48. The IBCF#3 forwards the 200 OK to the AS/MRFC.

8.8.1.2.4 Primary i3 PSAP Disconnects from the Conference

After conferencing with the calling party and the Secondary PSAP, the Primary PSAP wants the Secondary PSAP to take over the handling of the call. The Primary PSAP drops out of the conference. This call flow illustrates the release of Primary PSAP from the call path.

8.8.1.2.4.1 Secondary PSAP is an i3 PSAP

This call flow illustrates a call flow scenario where the secondary PSAP is an i3 PSAP.

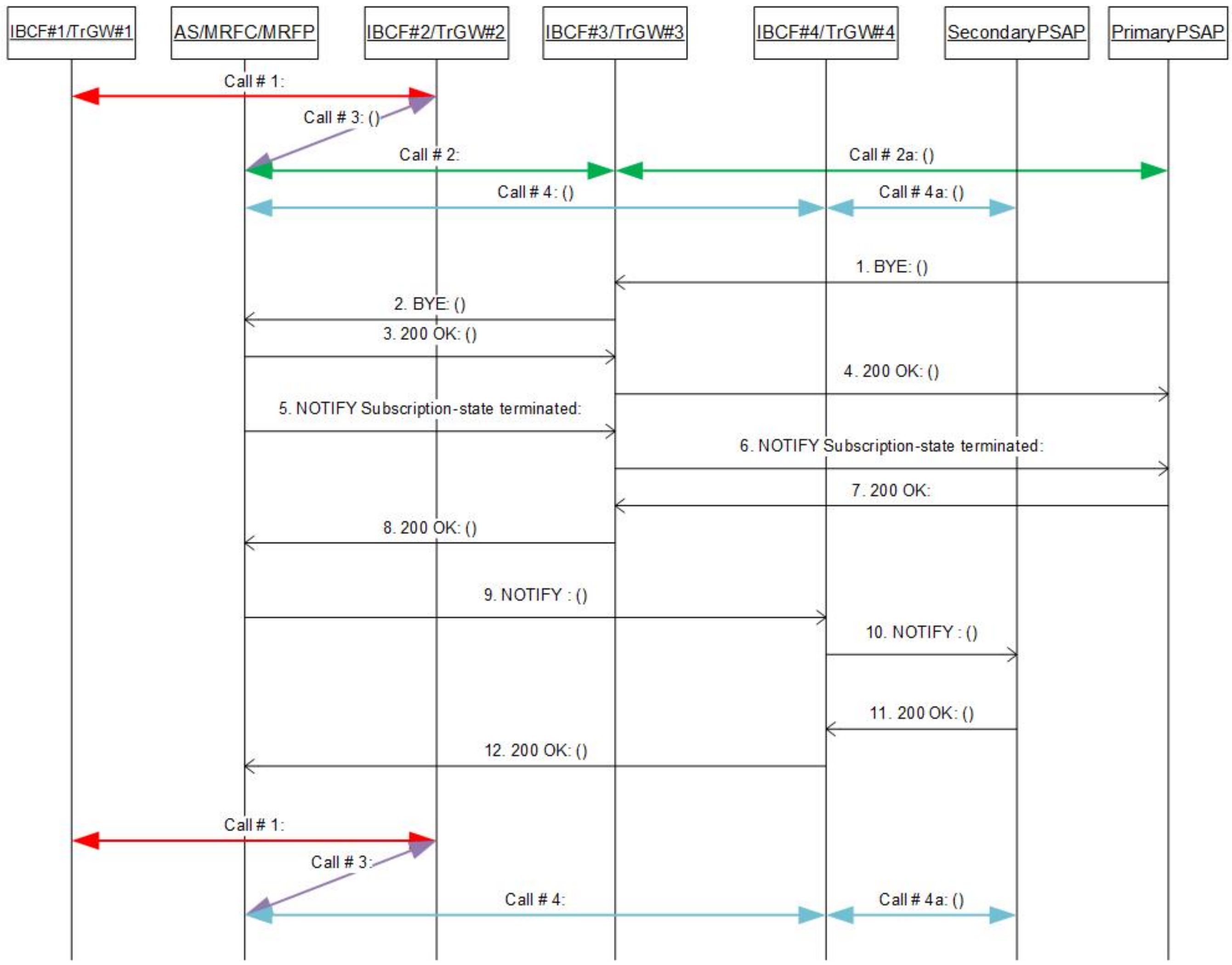

Figure 8-31: Primary i3 PSAP Drops out of Conference with Secondary i3 PSAP

Step 1. The Primary PSAP initiates a BYE towards the AS/MRFC to disconnect itself from the call via IBCF#3.

Step 2. The BYE is forwarded to AS/MRFC by the IBCF#3.

Step 3. The AS/MRFC acknowledges the BYE by replying with 200 OK back towards the Primary PSAP via IBCF#3.

Step 4. The IBCF#3 forwards the 200 OK to the Primary PSAP.

Step 5. The AS/MRFC sends a NOTIFY with subscription terminated indication to the Primary PSAP via IBCF#3.

Step 6. The IBCF#3 forwards the NOTIFY with subscription terminated indication to the Primary PSAP.

Step 7. The Primary PSAP sends a 200 OK towards the AS/MRFC via IBCF#3.

Step 8. The IBCF#3 forwards the 200 OK to the AS/MRFC.

Step 9. The AS/MRFC sends a NOTIFY via the IBCF#4 toward the Secondary PSAP indicating the latest call state.

Step 10. The IBCF#4 forwards the NOTIFY to the Secondary PSAP.

Step 11. The Secondary PSAP replies back with a 200 OK.

Step 12. The IBCF#4 forwards the 200 OK to the AS/MRFC.

8.8.1.2.4.2 Secondary PSAP is a Legacy PSAP

This call flow illustrates a call flow scenario where the secondary PSAP is a legacy PSAP.

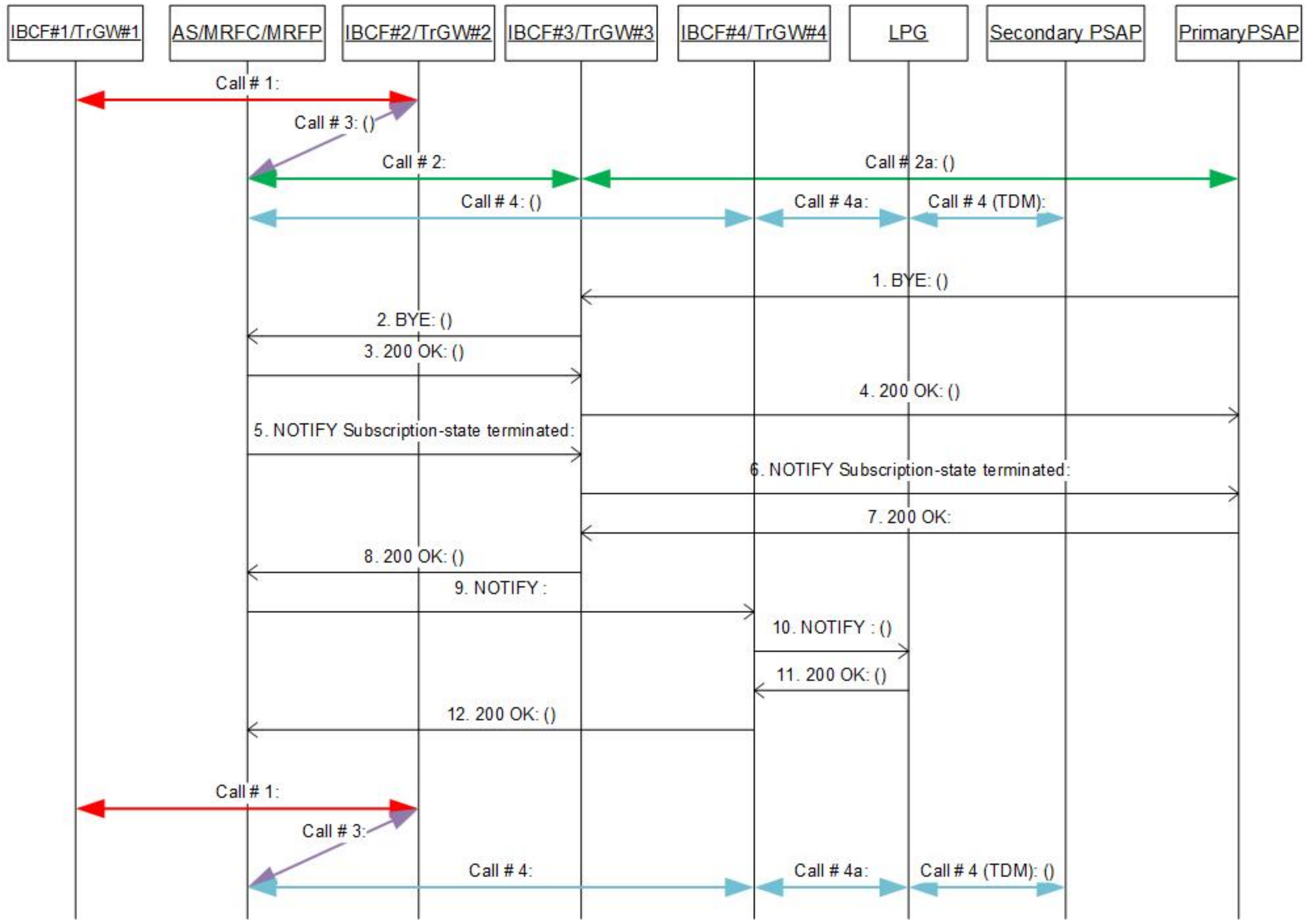

Figure 8-32: Primary i3 PSAP Drops out of Conference with Secondary Legacy PSAP

Step 1. The Primary PSAP initiates a BYE towards the AS/MRFC to disconnect itself from the call via IBCF#3.

Step 2. The BYE is forwarded to the AS/MRFC by IBCF#3.

Step 3. The AS/MRFC acknowledges the BYE by replying with 200 OK back towards the Primary PSAP via IBCF#3.

Step 4. The IBCF#3 forwards the 200 OK to the Primary PSAP.

Step 5. The AS/MRFC sends a NOTIFY with subscription terminated indication to the Primary PSAP via IBCF#3.

Step 6. The IBCF#3 forwards the NOTIFY with subscription terminated indication to the Primary PSAP.

Step 7. The Primary PSAP sends a 200 OK towards the AS/MRFC via IBCF#3.

Step 8. The IBCF#3 forwards the 200 OK to the AS/MRFC.

Step 9. The AS/MRFC sends a NOTIFY to the LPG via IBCF#4 indicating the latest state of the call.

Step 10. The IBCF#4 forwards the NOTIFY to the LPG.

Step 11. The LPG replies back with a 200 OK to the AS/MRFC via IBCF#4.

Step 12. The IBCF#4 forwards the 200 OK to the AS/MRFC.

8.8.1.2.5 Secondary PSAP Completes the Transfer from the Conference

Since it is a two-party call between the calling party and the Secondary PSAP, there is no reason to retain the conference bridge. The Secondary PSAP initiates the release of AS/MRFC from the call. The Secondary PSAP sets up a direct connection with the calling party through Call #5 at IBCF#2.

8.8.1.2.5.1 Secondary PSAP is an i3 PSAP

This call flow illustrates the release of AS/MRFC from the conference by the Secondary i3 PSAP.

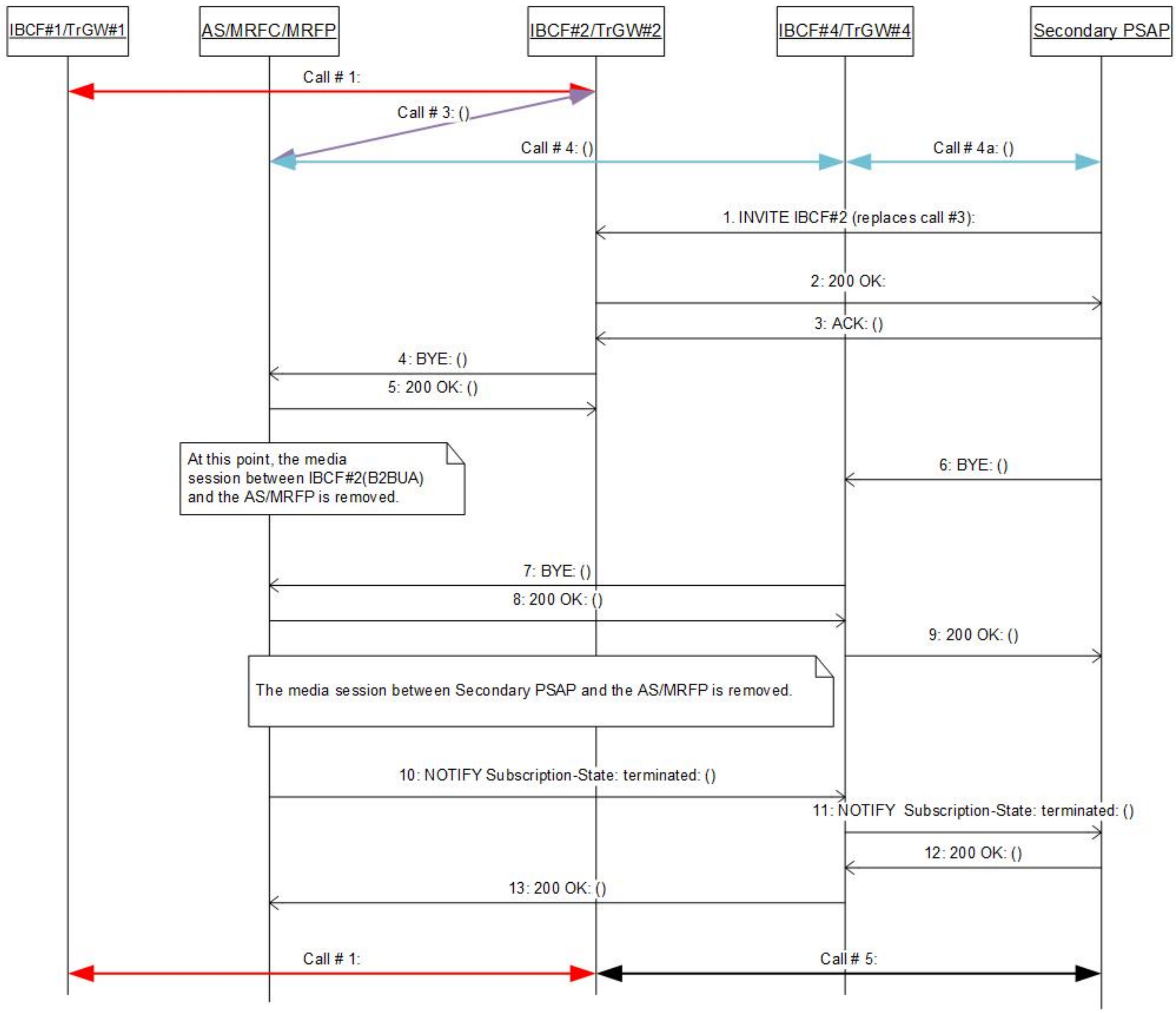

Figure 8-33: Conference AS/MRFC Released by Secondary i3 PSAP

Step 1. The Secondary PSAP initiates an INVITE towards IBCF#2 to replace call #3 with a direct connection of the Secondary PSAP via call #5.

Step 2. The IBCF#2 sends a 200 OK back to the Secondary PSAP.

Step 3. The Secondary PSAP sends an ACK in response to the 200 OK back to the IBCF#2.

Step 4. The IBCF#2 sends a BYE to the AS/MRFC to remove the media between IBCF#2 and the AS/MRFC.

Step 5. The AS/MRFC sends a 200 OK back to the IBCF#2. At this point the media between IBCF#2 and AS/MRFC is switched between IBCF#2 and the Secondary PSAP represented by call #5.

Step 6. The Secondary PSAP initiates the release of AS/MRFC from the call by sending a BYE via IBCF#4.

Step 7. The IBCF#4 forwards the BYE to the AS/MRFC.

Step 8. The AS/MRFC sends a 200 OK in response towards the Secondary PSAP.

Step 9. The IBCF#4 forwards the 200 OK to the Secondary PSAP. At this point the media session between Secondary PSAP and AS/MRFC is switched between the IBCF#2 and the Secondary PSAP represented by call #5.

Step 10. The AS/MRFC sends a NOTIFY with subscription state terminated indication towards the Secondary PSAP via IBCF#4.

Step 11. The IBCF#4 forwards the NOTIFY with subscription state terminated indication to the Secondary PSAP.

Step 12. The Secondary PSAP sends the 200 OK to the AS/MRFC via IBCF#4.

Step 13. The IBCF#4 forwards the 200 OK to the AS/MRFC.

At this point AS/MRFC is no longer involved with the conference. The original call (call #1) is directly connected to Secondary PSAP at IBCF#2/TrGW#2.

8.8.1.2.5.2 Secondary PSAP is a Legacy PSAP

This call flow illustrates the release of AS/MRFC from the conference by the secondary legacy PSAP.

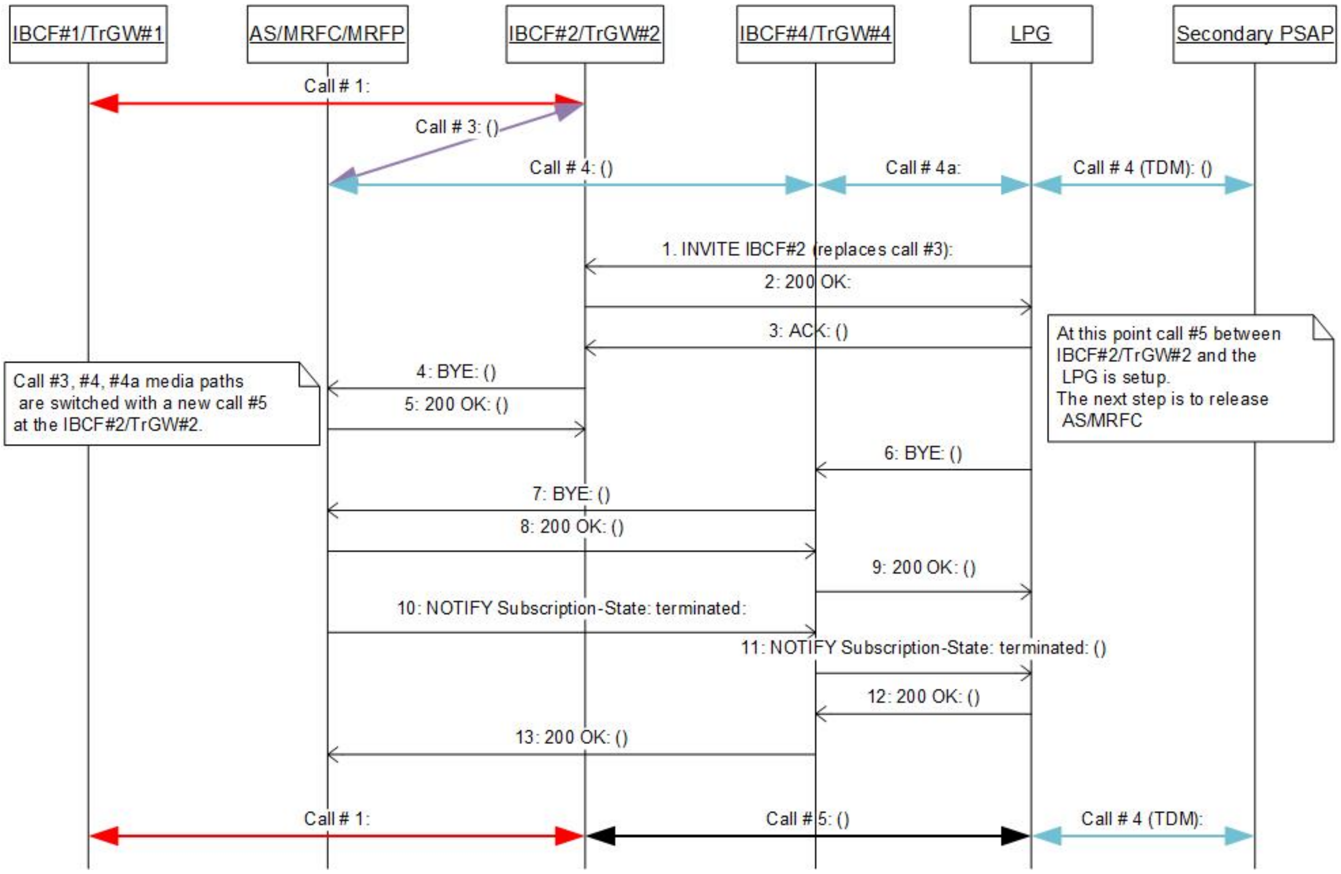

Figure 8-34: Conference AS/MRFC Released by Secondary Legacy PSAP

Step 1. The LPG initiates an INVITE towards IBCF#2 to replace call #3 with a direct connection of the original call #1 with the Secondary PSAP via LPG through call #5.

Step 2. The IBCF#2 sends a 200 OK back to the LPG.

Step 3. The LPG sends an ACK in response to the 200 OK back to the IBCF#2.

Step 4. The IBCF#2 sends a BYE to the AS/MRFC to remove the media between IBCF#2 and the AS/MRFC to remove call #3.

Step 5. The AS/MRFC sends a 200 OK back to the IBCF#2. At this point the media between IBCF#2 and AS/MRFC is switched.

Step 6. The LPG initiates the release of AS/MRFC from the call by sending a BYE to the AS/MRFC via IBCF#4.

Step 7. The IBCF#4 forwards the BYE to the AS/MRFC.

Step 8. The AS/MRFC sends a 200 OK in response towards the LPG via IBCF#4.

Step 9. The IBCF#4 forwards the 200 OK to the LPG. At this point the media session between Secondary PSAP and AS/MRFC is switched.

Step 10. The AS/MRFC sends a NOTIFY with subscription state terminated indication towards the LPG via IBCF#4.

Step 11. The IBCF#4 forwards the NOTIFY with subscription state terminated indication to the LPG.

Step 12. The LPG sends the 200 OK to the AS/MRFC via IBCF#4.

Step 13. The IBCF#4 forwards the 200 OK to the AS/MRFC.

At this point AS/MRFC is no longer involved with the conference. The original call (call #1) is directly connected to the Secondary PSAP at IBCF#2/TrGW#2. The TDM call #4 between LPG and Secondary Legacy PSAP stays intact.

8.8.2 Support for Emergency Call Transfer Requests from Legacy PSAPs to Secondary PSAPs/Destinations

Like transfers initiated by i3 PSAPs, when a legacy PSAP initiates a transfer, it must first create a conference on a bridge. As described in Clause 8.8.1, this bridge supports multimedia (voice, video, text) and resides in a conferencing AS. Media control for the conference is provided by an MRFC and media mixing is provided by an MRFP in the IMS-based NG9-1-1 Emergency Services Network.

The following subsections describe flows associated with a transfer that is initiated by a legacy PSAP:

- Clause 8.8.2.1 covers Primary Legacy PSAP call scenario when media anchoring is done at the originating network-facing IBCF.
- Clause 8.8.2.2 covers Primary Legacy PSAP call scenario when media anchoring is done at the PSAP-facing IBCF.

8.8.2.1 Media Anchoring at Originating Network-Facing IBCF Conditional on Supported Header

This Section describes a scenario where a legacy PSAP initiates the transfer of an emergency call. This scenario assumes that the calling device does not support the Replaces header, and the INVITE method with the Replaces header generated by the conferencing AS will be directed to an originating network-facing IBCF operating as a B2BUA rather than to the calling device.

8.8.2.1.1 Conference Establishment

The flow depicted in Figure 8-35 illustrates the mechanism by which a legacy PSAP creates a conference at a conferencing AS. This call flow assumes that upon receiving an emergency session request, 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 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 the legacy PSAP via a PSAP-facing IBCF (not shown) that is operating as a proxy (or as a B2BUA that does not modify received headers, as described in RFC 7092 [Ref 33]), and a Legacy PSAP Gateway. In this example, the (Primary) legacy PSAP determines that the call must be transferred and initiates the transfer by sending Dual Tone Multi-Frequency (DTMF) signaling to the LPG. The LPG interprets the incoming DTMF signaling, and interacts with a conferencing AS/MRFC to create a conference to support the transfer of the emergency call. The call flow illustrated in Figure 8-35 assumes that the calling device does not support the Replaces header, and 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.

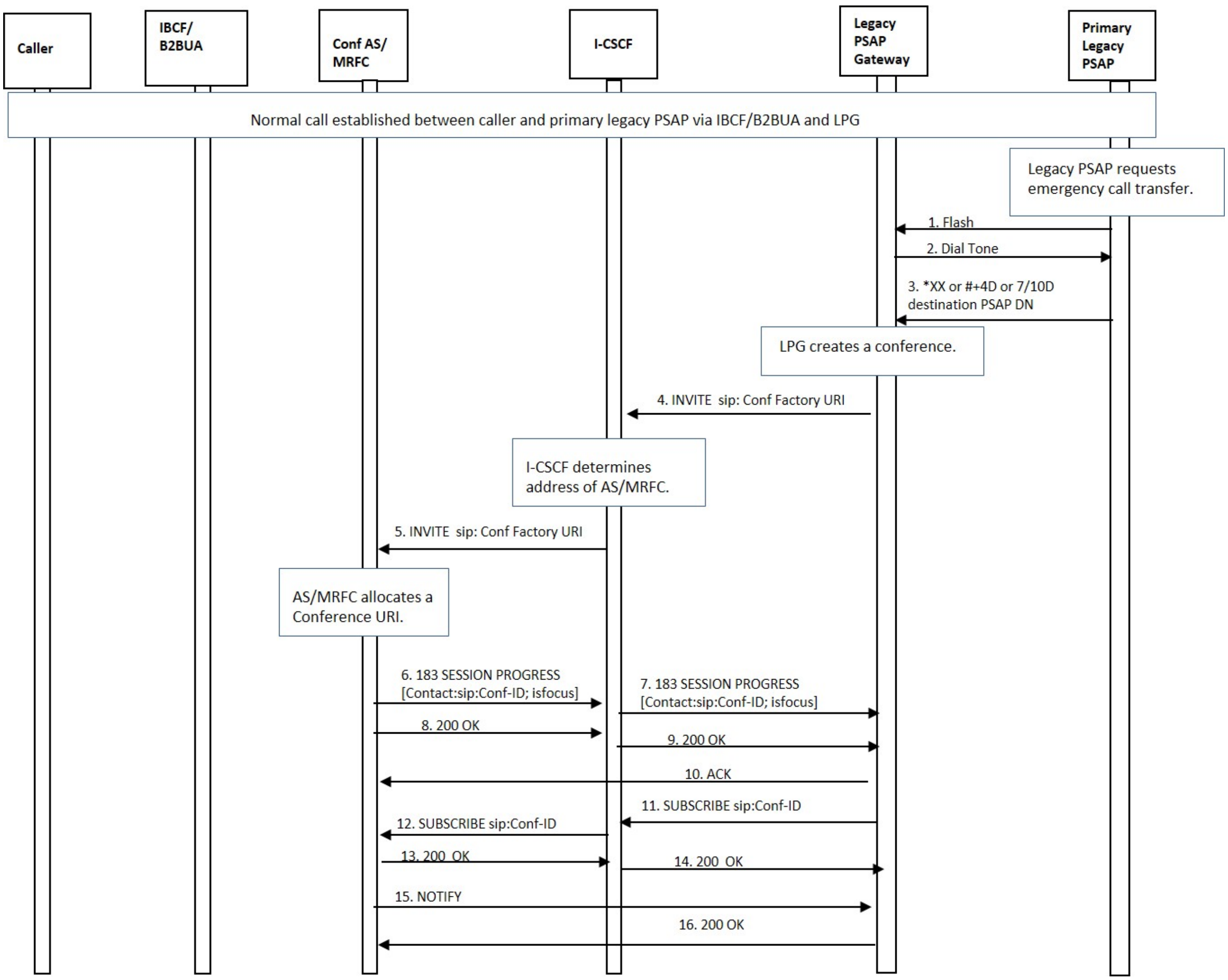

Figure 8-35: Legacy PSAP Requests Transfer; LPG Establishes Conference with Conferencing AS/MRFC

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

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

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

Step 4. The LPG 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 LPG. The SIP INVITE message includes 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 5. The I-CSCF forwards the SIP INVITE message to the conferencing AS/MRFC.

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 6. 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 7. The I-CSCF passes the 183 SESSION PROGRESS message (via an IBCF [not shown]) to the LPG.

Step 8. The conferencing AS/MRFC then returns a 200 OK message to the I-CSCF, to establish a session with the legacy PSAP via the LPG.

Step 9. The I-CSCF sends a 200 OK message (via an IBCF [not shown]) to the LPG.

Step 10. The LPG 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 legacy PSAP and the conferencing AS/MRFC. Note that the media session between the IBCF/B2BUA and the Primary legacy PSAP still exists at this time.

Step 11. The LPG 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 12. The I-CSCF passes the SIP SUBSCRIBE message to the conferencing AS/MRFC.

Step 13. The conferencing AS/MRFC acknowledges the subscription request by sending a 200 OK message back to the I-CSCF.

Step 14. The I-CSCF passes the OK message to the LPG via an IBCF (not shown).

Step 15. The conferencing AS/MRFC then returns a NOTIFY message to the LPG via an IBCF (not shown) to provide subscription status information.

Step 16. The LPG responds by returning a 200 OK message via an IBCF (not shown) to the conferencing AS/MRFC.

8.8.2.1.2 LPG Requests that the Conferencing AS Invite the IBCF/B2BUA to the Conference

After the LPG establishes the conference, it sends a REFER method to the conferencing AS/MRFC asking it to invite the IBCF/B2BUA to the conference. (As specified above, this flow assumes that the calling device does not support the Replaces header and that the Primary PSAP/LPG-facing IBCF [not shown] is operating as a proxy or as a B2BUA that does not modify received headers.) This portion of the emergency call transfer flow is the same as illustrated in Figure 8-20, with the LPG replacing the i3 PSAP.

8.8.2.1.3 LPG Requests that the Conferencing AS Invite the Secondary PSAP to the Conference

Once the conferencing AS/MRFC has invited the IBCF/B2BUA to the conference, the LPG requests that the conferencing AS/MRFC invite the Secondary PSAP to the conference by generating a REFER method following the procedures specified in RFC 7647 [Ref 34], with a Refer-To header that contains the URI of the transfer-to PSAP/agency, determined using one of the following methods. (See Section 7.2.2.4 of NENA-STA-010.2 for further details.)

- If the LPG receives a 7/10-digit destination number in the DTMF signaling from the legacy PSAP it will use this information to populate the URI in the Refer-To header of the outgoing REFER method.
- If the LPG receives a "# + 4-digits" via DTMF signaling from the legacy PSAP, it will add the appropriate NPA-NXX digits at the beginning of the 4-digit string, and use this information to populate the URI in the Refer-To header of the outgoing REFER method.
- If the LPG receives a code of the form "*XX" in the DTMF signaling from the legacy PSAP, it will do one of the following, based on trunk group provisioning:
  - The LPG will map the received "*XX" code to a static URI, and populate this URI in the Refer-To header of the outgoing REFER method.
  - The LPG will map the received "*XX" code to a service URN, and query an ECRF using this service URN and the location information received with the call. The LPG will then use the URI returned in the response from the ECRF to populate the Refer-To header of the outgoing REFER method.[26]

The procedures used by an LPG to request that the conferencing AS/MRFC invite the Secondary PSAP to the conference follow the flows illustrated in Figure 8-21 and Figure 8-22, with the LPG replacing the i3 PSAP in those flows. Note that the LPG 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 reference], as well as any Additional Data structures received with the call). If the LPG receives Additional Data "by value" with the call, the LPG will populate it in the EIDD by value. If the LPG receives Additional Data "by reference" with the call, it will populate it in the EIDD by reference. The LPG will include the EIDD by-reference in the SIP REFER method that it generates, following the procedures described in Section 8.8.1.1.3.1. While the LPG does not know all of the information that the Primary PSAP may have acquired in its handling of the call, it is expected pass whatever information it has to the Secondary PSAP, following the procedures described in Section 8.8.1.1.3.1.

8.8.2.1.4 Primary Legacy PSAP Disconnects from the Conference

Once the Primary legacy PSAP determines that the transfer can be completed, the Primary legacy PSAP disconnects from the conference, as illustrated in Figure 8-36 and Figure 8-37.

8.8.2.1.4.1 Secondary PSAP is an i3 PSAP

This call flow illustrates a scenario when the Secondary PSAP is an i3 PSAP.

[26] This will require that the LPG be able to map all of the *XX codes supported by each PSAP that it serves to an appropriate service URN value that it can use to obtain the associated transfer-to destination address from the ECRF.

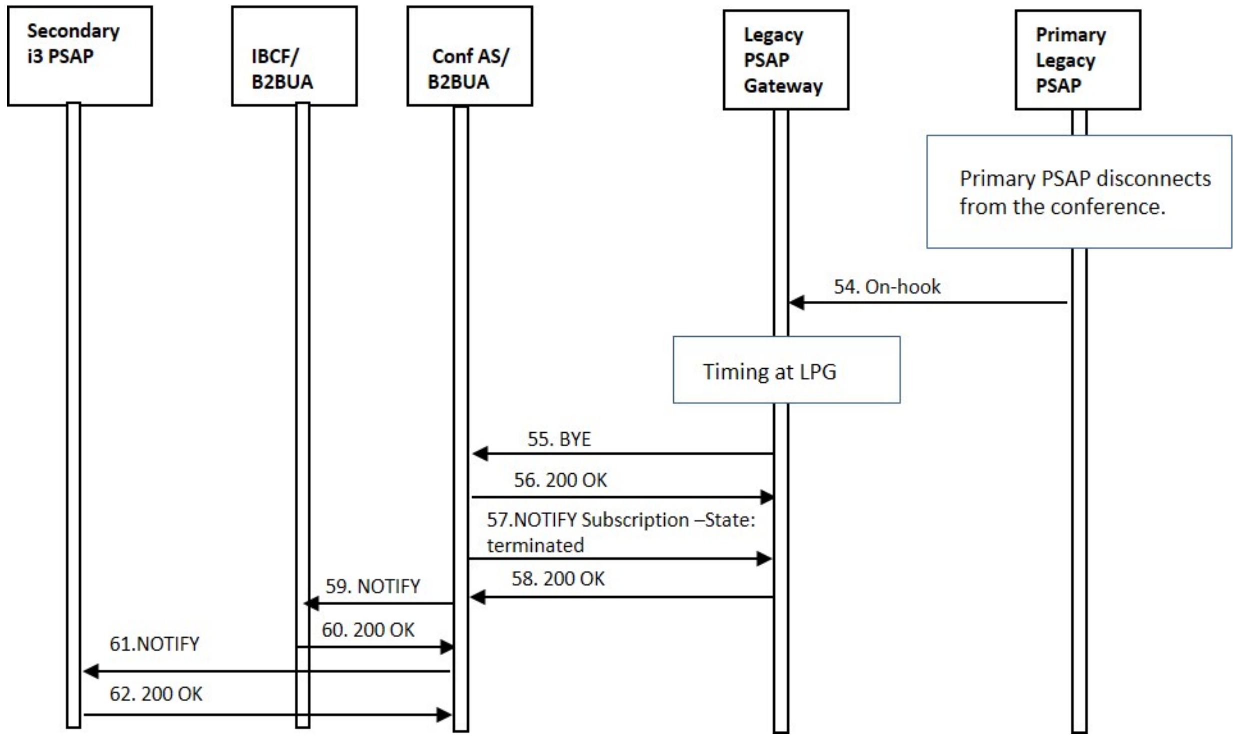

Figure 8-36: Primary Legacy PSAP Disconnects from the Conference – Secondary PSAP is an I3 PSAP

Step 54. Upon determining that the emergency call transfer should be completed, the Primary legacy PSAP disconnects from the call by sending an on-hook signal to the LPG.

The LPG sets a timer to distinguish a disconnect indication from a flash signal.

Step 55. When the LPG determines that the PSAP has disconnected, it sends a BYE message to the conferencing AS/MRFC (via the IBCF [not shown]).

Step 56. The conferencing AS/MRFC responds by returning a 200 OK message.

Step 57. The conferencing AS/MRFC then returns a NOTIFY message to the LPG (via the IBCF [not shown]) indicating that the subscription to the conference has been terminated.

Step 58. The LPG returns a 200 OK message in response to the NOTIFY message.

Step 59. The conferencing AS/MRFC then returns a NOTIFY message to the IBCF/B2BUA indicating that there has been a change to the subscription state.

Step 60. The IBCF/B2BUA returns a 200 OK message in response to the NOTIFY message.

Step 61. The conferencing AS/MRFC then returns a NOTIFY message to the Secondary i3 PSAP (via the IBCF [not shown]) indicating that there has been a change to the subscription state.

Step 62. The Secondary i3 PSAP returns a 200 OK message in response to the NOTIFY message.

8.8.2.1.4.2 Secondary PSAP is a Legacy PSAP

This call flow illustrates a scenario when the Secondary PSAP is a legacy PSAP.

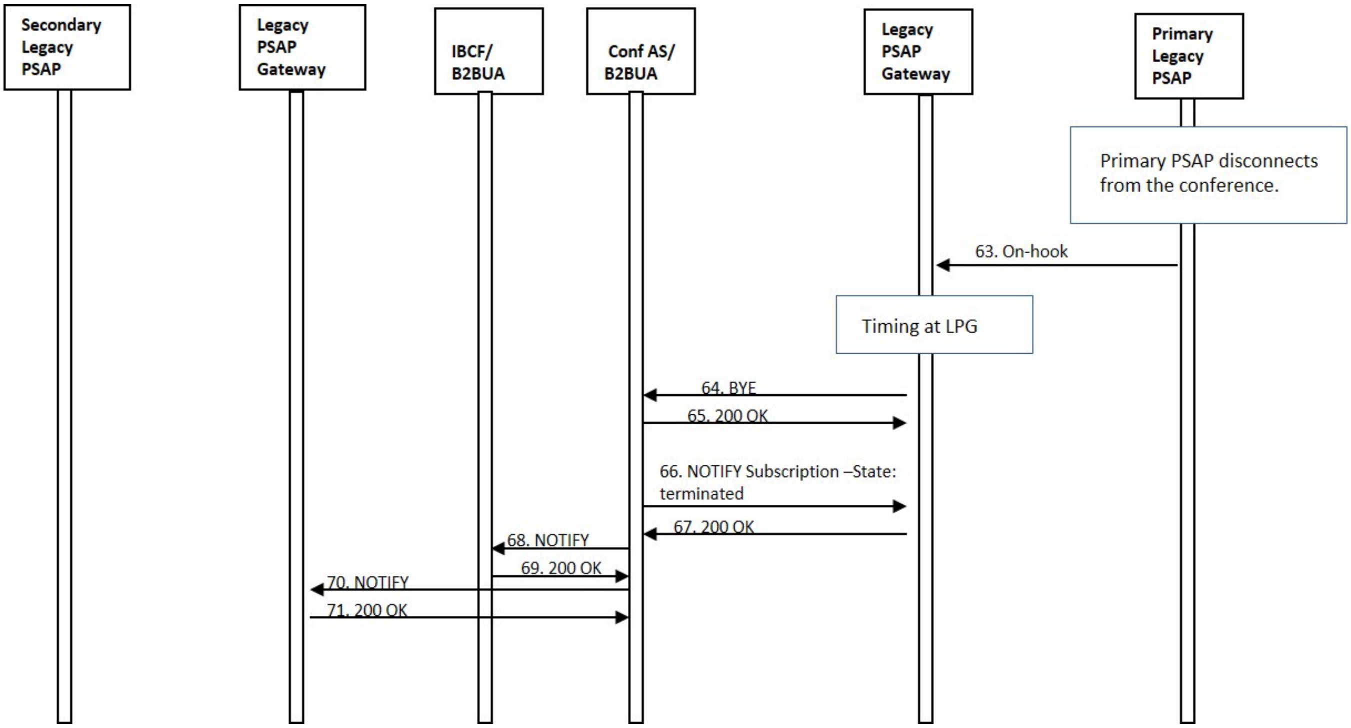

Figure 8-37: Primary Legacy PSAP Disconnects from the Conference – Secondary PSAP is a Legacy PSAP

Step 63. Upon determining that the emergency call transfer should be completed, the Primary legacy PSAP disconnects from the call by sending an on-hook signal to the LPG.

The LPG sets a timer to distinguish a disconnect indication from a flash signal.

Step 64. When the LPG determines that the PSAP has disconnected, it sends a BYE message to the conferencing AS/MRFC (via the IBCF [not shown]).

Step 65. The conferencing AS/MRFS responds by returning a 200 OK message.

Step 66. The conferencing AS/MRFC then returns a NOTIFY message to the LPG (via the IBCF [not shown]) indicating that the subscription to the conference has been terminated.

Step 67. The LPG returns a 200 OK message in response to the NOTIFY message.

Step 68. The conferencing AS/MRFC then returns a NOTIFY message to the IBCF/B2BUA indicating that there has been a change to the subscription state.

Step 69. The IBCF/B2BUA returns a 200 OK message in response to the NOTIFY message.

Step 70. The conferencing AS/MRFC then returns a NOTIFY message to the LPG (via the IBCF [not shown]) indicating that there has been a change to the subscription state.

Step 71. The LPG returns a 200 OK message in response to the NOTIFY message.

8.8.2.1.5 Secondary PSAP Completes the Transfer

The Secondary PSAP then completes the transfer as illustrated in Figure 8-25 and Figure 8-26. As described in Section 8.8.1.1.5.1, the connection between the caller and the IBCF/B2BUA is unaffected by the completion of the transfer by the Secondary PSAP.

8.8.2.2 Media Anchoring at PSAP-Facing IBCF

This Section provides the call flows where the media anchoring is done at the PSAP-facing IBCF/TrGW. In these call flows the Primary PSAP is a legacy PSAP.

8.8.2.2.1 Conference Establishment

The call flow below illustrates the mechanism by which a legacy PSAP creates a conference at AS/MRFC. The scenario illustrated in this call flow is for media to be anchored at the PSAP-facing IBCF/B2BUA. The (Primary) legacy PSAP determines that the call must be transferred and initiates the transfer by sending DTMF signaling to the LPG. The LPG interprets the incoming DTMF signaling, and interacts with a conferencing AS/MRFC to create a conference to support the transfer of the emergency call.

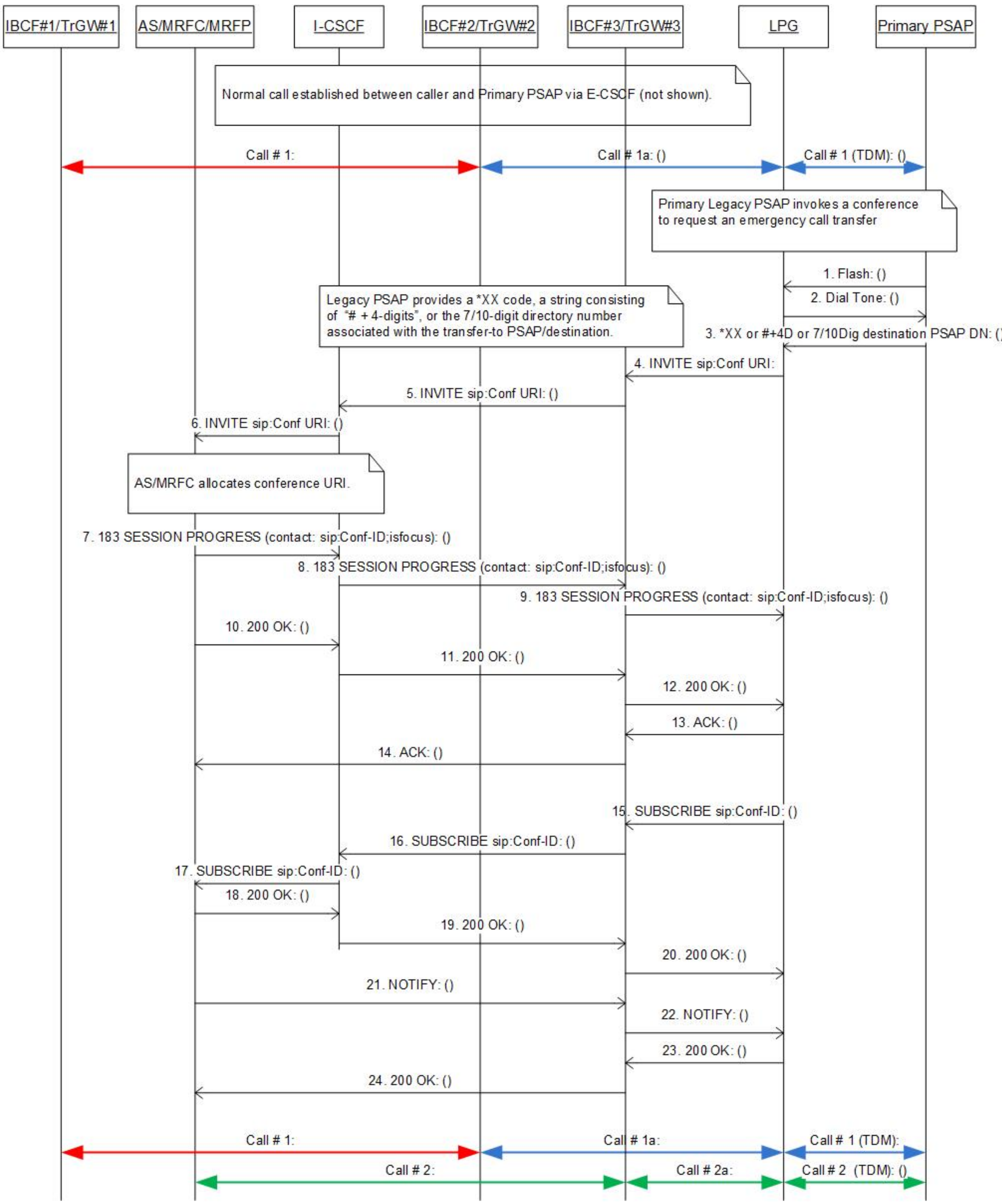

Figure 8-38: Legacy PSAP Establishes Conference with Conferencing AS/MRFC

Step 1. The Primary PSAP decides to transfer the emergency call and initiates the transfer by sending a flash indication to the LPG.

Step 2. The LPG generates a dial tone signal in response back to the Primary PSAP.

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

Step 4. The LPG creates the conference by first sending an INVITE towards the AS/MRFC via IBCF#3 using a conference factory URI that is known by/provisioned at the LPG. The SIP INVITE message includes a Resource Priority Header set to “esnet.1” to indicate that the session request is associated with the transfer of an emergency call.

Step 5. The IBCF#3 forwards the INVITE to the I-CSCF.

Step 6. The I-CSCF determines the address of the conferencing AS/MRFC and forwards the INVITE to the AS/MRFC.

NOTE: I-CSCF does not add itself to the Record-Route header.

Step 7. 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. The conferencing AS/MRFC responds to the INVITE by returning a 183 SESSION PROGRESS to the I-CSCF. The Contact header contains the conference URI for the conference allocated at the AS/MRFC and the "isfocus" feature parameter indicating a conference call.

Step 8. The I-CSCF forwards the 183 SESSION PROGRESS to the IBCF#3.

Step 9. The IBCF#3 forwards the 183 SESSION PROGRESS to the LPG.

Step 10. The AS/MRFC sends a 200 OK to the I-CSCF in response to the INVITE message.

Step 11. The I-CSCF forwards the 200 OK to the IBCF#3.

Step 12. The IBCF#3 forwards the 200 OK to the LPG.

Step 13. The LPG returns an ACK acknowledging the receipt of 200 OK to the IBCF#3.

Step 14. The IBCF#3 forwards the ACK to AS/MRFC.

At this point the media session is established between MRFP and the Primary PSAP and denoted as call #2. However, the UE is still connected to Primary PSAP as call #1.

Step 15. The LPG sends a SUBSCRIBE to AS/MRFC to stay informed regarding the status of conference call to the IBCF#3.

Step 16. The IBCF#3 forwards the SUBSCRIBE to the I-CSCF.

Step 17. The I-CSCF forwards the SUBSCRIBE to the AS/MRFC.

Step 18. The AS/MRFC sends a 200 OK back to the I-CSCF.

Step 19. The I-CSCF forwards the 200 OK to the IBCF#3.

Step 20. The IBCF#3 forwards the 200 OK to the LPG.

Step 21. The AS/MRFC sends a NOTIFY to the LPG via IBCF#3.

Step 22. The IBCF#3 forwards the NOTIFY to the LPG.

Step 23. The LPG sends a 200 OK back to the AS/MRFC in response to NOTIFY via IBCF#3.

Step 24. The IBCF#3 forwards the 200 OK to the AS/MRFC.

8.8.2.2.2 LPG Requests that the Conferencing AS Bridge the Original Call at IBCF#2/B2BUA

Once a new media path is established between LPG and AS/MRFP, the LPG sends a REFER to the AS/MRFC requesting that it INVITE IBCF#2/B2BUA to the conference. As a result, the AS/MRFC initiates an INVITE towards PSAP-facing IBCF#2/B2BUA to the conference. The intent of this call flow is to show a new media establishment between AS/MRFP and the IBCF#2/B2BUA. This portion of the emergency call transfer flow is the same as illustrated in Section 8.8.1.2.2 Figure 8-28: Application Server (AS) Bridges Call #1 and Call #2 via IBCF#2 with the LPG replacing the i3 PSAP.

8.8.2.2.3 LPG Requests that the Conferencing AS Invite the Secondary PSAP to the Conference

At this point the original call is connected through the conference, the LPG then requests the AS/MRFC to invite the Secondary PSAP to the call using REFER per RFC 7647 [Ref 34]. The rules to generate the URI in the Refer-To field as described in Section 8.8.2.1.3 will also apply in this Section.

For media anchoring at PSAP-facing IBCF, either scenarios; when the secondary PSAP is a legacy PSAP or an i3 PSAP, is already covered in Section 8.8.1.2.3.1 Figure 8-29: Application Server (AS) Invites Secondary i3 PSAP to Conference and Section 8.8.1.2.3.2 Figure 8-30: Application Server (AS) Invites Secondary Legacy PSAP to Conference. The only difference in the call flows in Section 8.8.1.2.3.1 and Section 8.8.1.2.3.2 is that since the Primary PSAP is a legacy PSAP, the LPG replaces the i3 PSAP in the flow. The rules to generate the EIDD either by-reference or by-value are same as described in Section 8.8.2.1.3.

8.8.2.2.4 Primary Legacy PSAP Disconnects from the Conference

Upon a successful conference establishment between the caller and the Secondary PSAP, the Secondary PSAP can take over the handling of the call. The Primary PSAP determines that the transfer can be completed and drops from the conference. This call flow illustrates the release of Primary PSAP from the call path during an emergency call transfer.

8.8.2.2.4.1 Secondary PSAP is an i3 PSAP

This call flow illustrates the disconnection of Primary legacy PSAP from the conference when the secondary PSAP is an i3 PSAP.

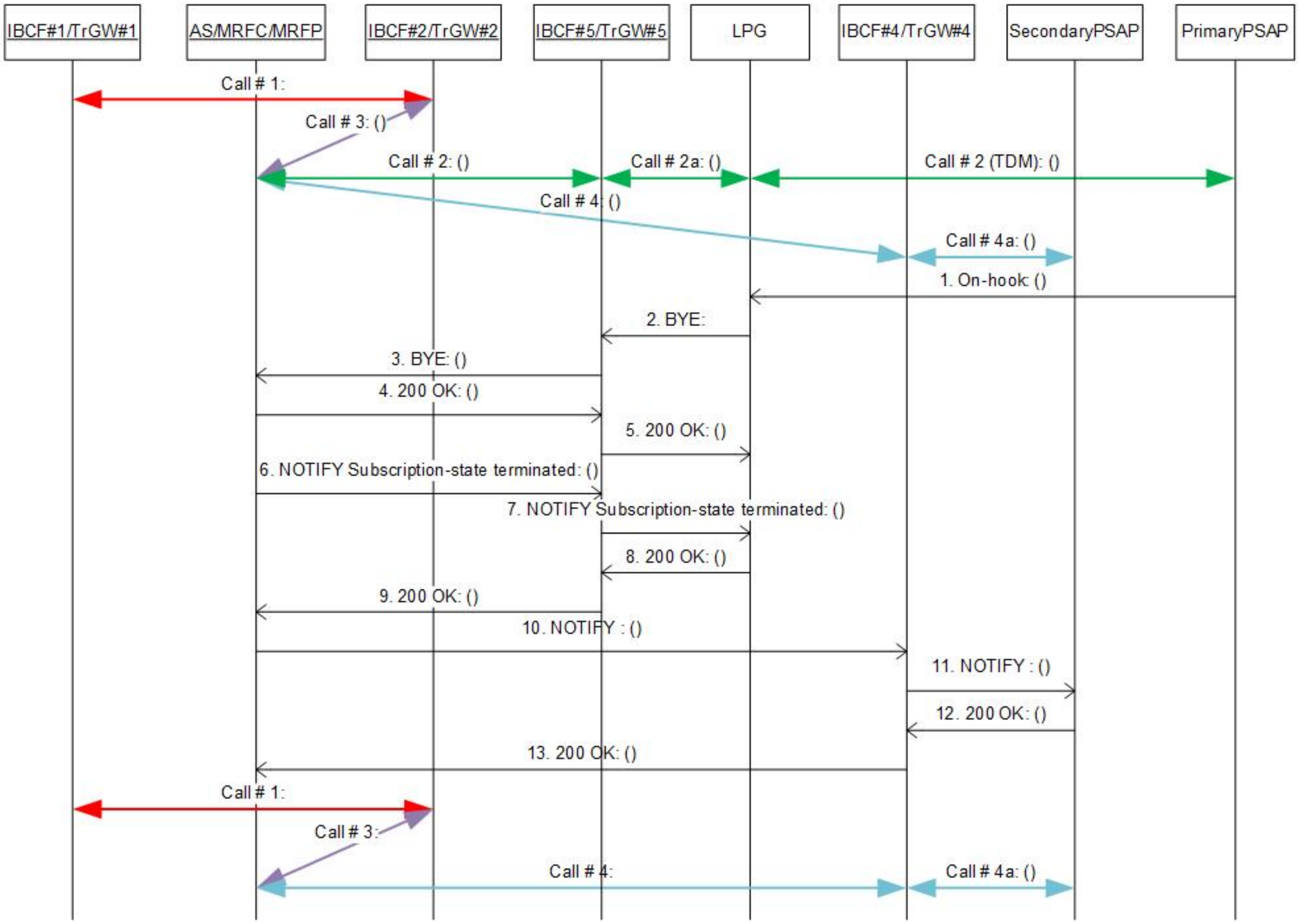

Figure 8-39: Primary Legacy PSAP Drops out of Conference with Secondary i3 PSAP

Step 1. The Primary PSAP initiates its disconnect from the conference by sending an “On-hook” indication to the LPG.

Step 2. The LPG generates a BYE towards the AS/MRFC to disconnect itself from the call via IBCF#5.

Step 3. The BYE is forwarded to the AS/MRFC by IBCF#5.

Step 4. The AS/MRFC acknowledges the BYE by replying with 200 OK back to the IBCF#5.

Step 5. The IBCF#5 forwards the 200 OK to the LPG.

Step 6. The AS/MRFC sends a NOTIFY with subscription terminated indication to the LPG via IBCF#5.

Step 7. The IBCF#5 forwards the NOTIFY with subscription terminated indication to the LPG.

Step 8. The LPG sends a 200 OK towards AS/MRFC via IBCF#5.

Step 9. The IBCF#5 forwards the 200 OK to the AS/MRFC.

Step 10. The AS/MRFC sends a NOTIFY to the Secondary PSAP via IBCF#4 indicating the latest call state.

Step 11. The IBCF#4 forwards the NOTIFY to the Secondary PSAP.

Step 12. The Secondary PSAP replies back with a 200 OK to the IBCF#4.

Step 13. The IBCF#4 forwards the 200 OK to the AS/MRFC.

8.8.2.2.4.2 Secondary PSAP is a Legacy PSAP

This call flow illustrates the disconnection of the Primary legacy PSAP from the conference when the Secondary PSAP is also a legacy PSAP.

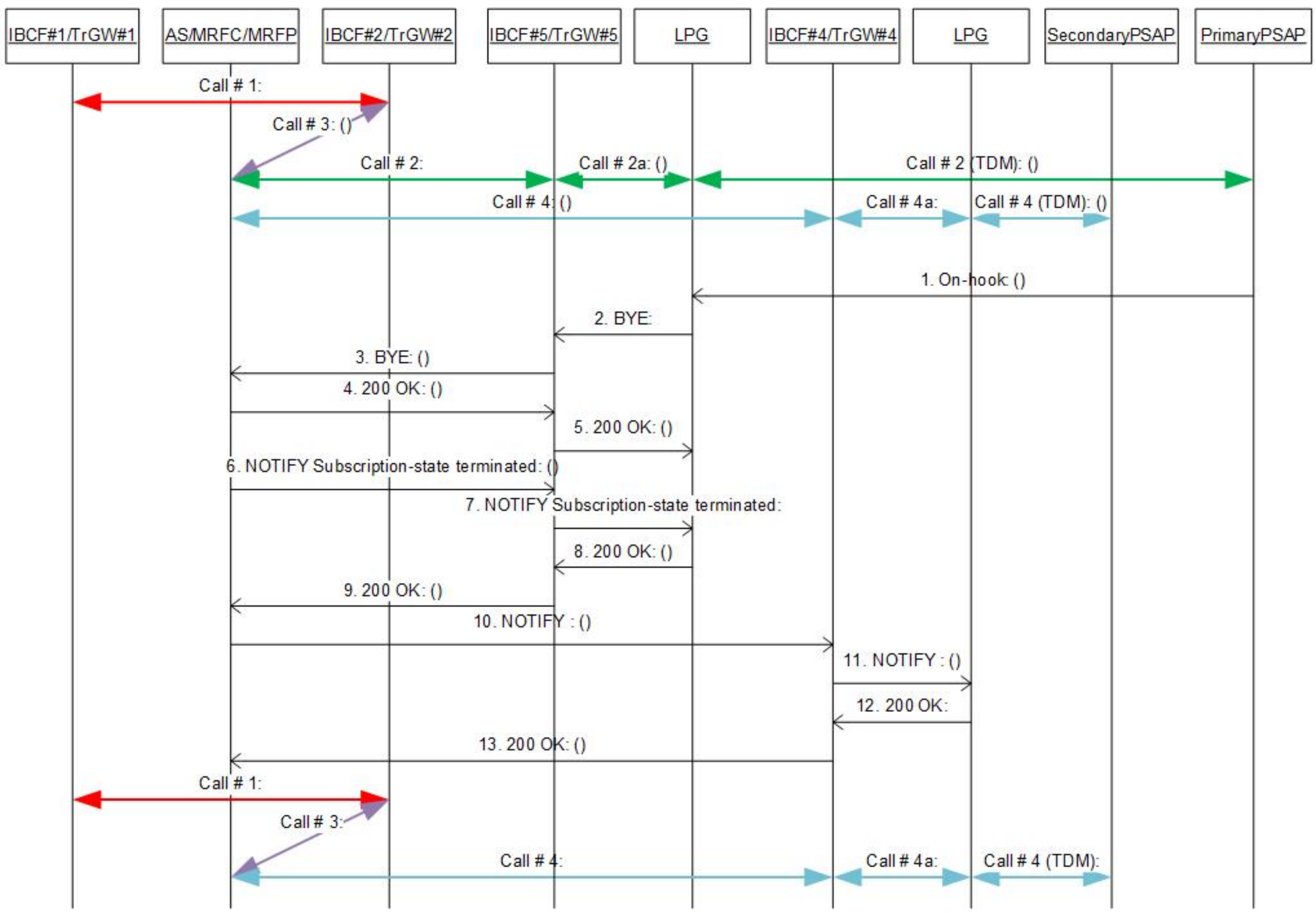

Figure 8-40: Primary Legacy PSAP Drops out of Conference with Secondary Legacy PSAP

Step 1. The Primary PSAP initiates its disconnect from the conference by sending an "On-hook" indication to the LPG.

Step 2. The LPG generates a BYE towards the AS/MRFC to disconnect itself from the call via IBCF#5.

Step 3. The BYE is forwarded to the AS/MRFC by the IBCF#5.

Step 4. The AS/MRFC acknowledges the BYE by replying with 200 OK back to the IBCF#5.

Step 5. The IBCF#5 forwards the 200 OK to the LPG.

Step 6. The AS/MRFC sends a NOTIFY with subscription terminated indication to the LPG via IBCF#5.

Step 7. The IBCF#5 forwards the NOTIFY with subscription terminated indication to the LPG.

Step 8. The LPG sends a 200 OK towards the AS/MRFC via IBCF#5.

Step 9. The IBCF#5 forwards the 200 OK to the AS/MRFC.

Step 10. The AS/MRFC sends a NOTIFY to the LPG via IBCF#4 indicating the latest call state.

Step 11. The IBCF#4 forwards the NOTIFY to the LPG.

Step 12. The LPG replies back with a 200 OK to the IBCF#4.

Step 13. The IBCF#4 forwards the 200 OK to the AS/MRFC.

8.8.2.2.5 Secondary PSAP Completes the Transfer

Since the Primary Legacy PSAP is no longer part of the call, the call flow procedure to release the AS/MRFC and complete the transfer in this step is same as described in Section 8.8.2.1.5. There are two possible scenarios to consider here.

In the first scenario, a Secondary i3 PSAP releases the AS/MRFC and completes the transfer. The call flow for this scenario is same as described in Section 8.8.1.2.5.1.

The second scenario is when the Secondary legacy PSAP releases the AS/MRFC and completes the transfer. The call flow for this scenario is same as described in Section 8.8.1.2.5.2.

8.9 Policy Routing Scenarios

In certain scenarios it is desirable for an emergency call to be routed to a different destination than the one associated with the Route URI provided by the RDF as a result of performing location-based routing. In an IMS-based NG9-1-1 Service Architecture, the initial PSAP URI returned by the RDF to the LRF may be overwritten with another PSAP URI based on the policy routing rules specified by the PSAP or the 9-1-1 Authority and provisioned in the Policy Routing Function (PRF). After the LRF receives routing instructions (i.e., a Route URI) from the RDF, it interrogates the PRF with the Route URI to determine if there are policy routing rules associated with that URI. Based on the policy routing rules, the PRF may obtain an alternate URI to be used in routing the emergency call. The Route URI that results from the application of location-based and policy-based routing is returned to the E-CSCF. The E-CSCF has no knowledge of whether the PSAP URI returned by LRF is the original one returned by the RDF or an alternate one determined by the PRF.

Policy routing allows for conditions/criteria other than location to be used in determining the routing of emergency calls. Routing decisions will be based on pre-provisioned policy rules that specify the conditions or decision criteria that should be considered (e.g., time-of-day) and the associated action that should be taken (e.g., alternate route for the call). Some of the reasons for routing a call to alternate PSAP could be:

- PSAP maintenance.
- PSAP state.
- Additional data associated with the call, caller or location.
- Type of call (voice, text, video, etc.)
- Pre-definition of disaster routing.
- PSAP operating hours (time of day or day of the week).

The following example illustrates how Policy Rules may be used within a PSAP routing policy:

IF <condition = true> THEN <perform this Action>

IF <condition 1> THEN <route to PSAP A>

IF <condition 2> THEN <route to PSAP B>

IF <condition 3> THEN <route to PSAP C>

Example:

IF (time of day >1800 OR <= 0500) THEN <route to PSAP C> //deliver the calls to PSAP-C, single shift PSAP
Between 6pm – 5am hours.

The call flow in Figure 8-41 illustrates an example of call routing to alternate PSAP due to policies enforced by Policy Routing Function (PRF). The call flow shows that the call was originally intended to be delivered to PSAP-A by the RDF based on the UE location. However due to PRF policies it was determined that the call cannot be delivered to PSAP-A, but instead must be delivered to PSAP-B. Thus the LRF/PRF returns the PSAP-B URI in the 300 Multiple Choices Response to E-CSCF. The E-CSCF forwards the call to PSAP-B via IBCF.

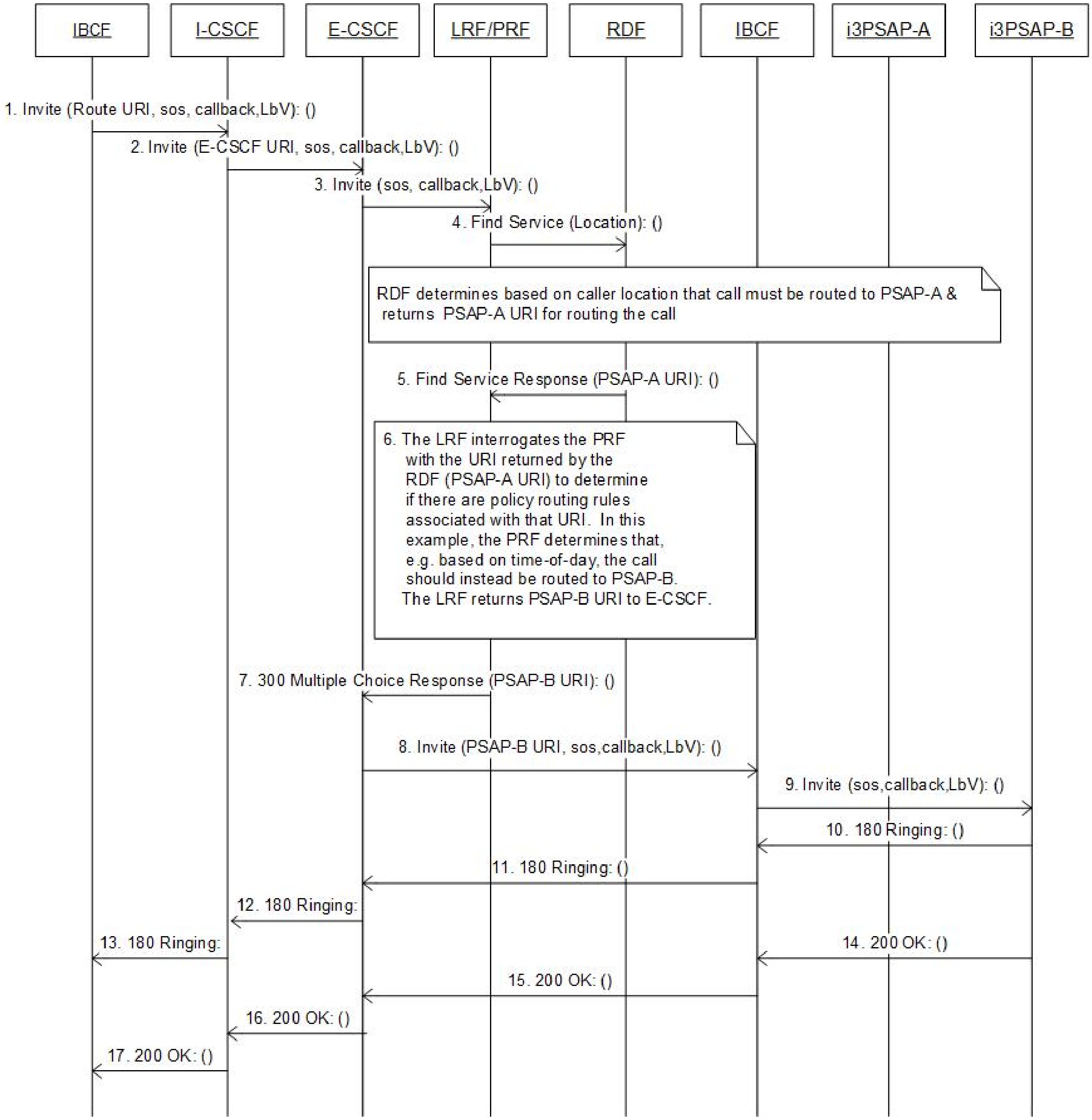

Figure 8-41: IMS Based Call to i3 PSAP – PRF Example

Step 1. The IBCF in IMS-based NG9-1-1 Emergency Services Network forwards the incoming invite message from IMS Originating network to I-CSCF. 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 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 and LbyV, as received in the incoming SIP INVITE message.

Step 3. The E-CSCF forwards the SIP INVITE to the LRF.

Step 4. LRF queries the RDF using the location information received in the body of the received SIP INVITE message.

Step 5. The RDF returns a Route URI. In this example, the Route URI is associated with an i3 PSAP-A that is served by the IMS-based NG9-1-1 Emergency Services Network.

Step 6. The LRF interrogates the PRF with the URI returned by the RDF (PSAP-A URI) to determine if there are policy routing rules associated with that URI. In this example, the PRF determines that, e.g., based on time-of-day, the call should instead be routed to PSAP-B. The LRF returns PSAP-B URI to E-CSCF.

Step 7. The LRF redirects the call back to E-CSCF by sending 300 Multiple Choice Response, passing the Route URI for PSAP-B.

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 IBCF.

Step 9. The IBCF forwards the SIP INVITE to the i3 PSAP-B with the callback information, the LbyV, and the Additional Data received in the initial SIP INVITE message from the IMS originating network.

Step 10. An indication that the call taker is being alerted is returned by the i3 PSAP to the IBCF (using a SIP 180 RINGING message).

Step 11. The IBCF passes the SIP 180 RINGING message to the E-CSCF.

Step 12. The E-CSCF passes the SIP 180 RINGING message to the I-CSCF.

Step 13. The I-CSCF passes the SIP 180 RINGING message to the IBCF.

Step 14. When the PSAP answers the call, it returns a SIP 200 OK message to the IBCF.

Step 15. The IBCF passes the SIP 200 OK message to the E-CSCF.

Step 16. The E-CSCF passes the SIP 200 OK message to the I-CSCF.

Step 17. The I-CSCF passes the SIP 200 OK message to the IBCF.

8.10 Failure Scenarios

This Section discusses some of the potential error cases that may be encountered during call set up and once the call is completed. It is not intended to be an exhaustive list of error cases, but highlights example scenarios.

This standard does not address the deployment of redundant functional elements, but it is assumed that the critical network elements will be redundant or deployed in an N+1 configuration. Given such a configuration, if a network element attempts to communicate with a downstream network element and detects an error (e.g., timeout) it should attempt to communicate with the redundant downstream network element. For example, if the I-CSCF and E-CSCF are deployed in separate physical units and the I-CSCF attempts to forward the SIP INVITE to the E-CSCF and receives a timeout, it should make the attempt to the redundant E-CSCF. This applies to all of the following error cases, but the error cases below describe action where there is a complete communication failure or the data is not available or corrupted.

8.10.1 Error Conditions

Upon encountering the following error conditions, it may not be possible to obtain location, identify the primary PSAP or determine the appropriate PSAP signaling format. Section 9.2.2 defines optional error handling for calls entering the IMS-based NG9-1-1 Emergency Services Network via SS7. If that is not implemented, the following handling applies. Except as noted, the recommended treatment for these scenarios is to forward the call to a default destination (e.g., a call center) to allow a human to determine how best to process the call.

- E-CSCF does not get a 300 Multiple Choices response from the LRF.

In this scenario the E-CSCF does not have sufficient information to determine the primary PSAP and the appropriate signaling method to route the call. The E-CSCF should route the call to a default destination (e.g., PSAP or call center).

- The LRF does not get a response from the LS.

There are two scenarios related to this condition: routing a fixed location call and routing a wireless call that uses associated location.

  - Fixed Location call.

Without the location the LRF cannot query the RDF to determine the primary PSAP. It should return a Route URI in the 300 Multiple Choices response that allows the E-CSCF to route the call to a default destination.

  - Wireless call routed using associated location.

If the LRF determines call routing using the associated location, then it can do so without a response from the LS. The LRF should return a Route URI in the 300 Multiple Choices response that allows the E-CSCF to route the call to a default destination.

  - If the LRF is unable to determine an associated location, it should return a Route URI in the 300 Multiple Choices response that allows the E-CSCF to route the call to a default destination.

- The LRF does not get a response from the RDF.

If the LRF does not get a response from the RDF it cannot determine the primary PSAP. It should return a Route URI in the 300 Multiple Choices response that allows the E-CSCF to route the call to a default destination.

- The E-CSCF gets an error in its attempt to forward the SIP INVITE toward the PSAP.

If the E-CSCF is unable to complete the dialogue with the primary PSAP it should redirect the call to a default destination.

8.11 PSAP Callback Flows

PSAP callback to a UE that previously originated an emergency call is treated like any other call to the UE.

9 Stage 3

This Section defines stage 3 procedures for the network elements within an IMS-based NG9-1-1 Emergency Services Network. This Section refers to 3GPP TS 24.229 [Ref 2] and illustrates the use within an emergency services network. This Section also illustrates header usage and examples.

9.1 Procedures & Header Usage for the Emergency CSCF (E-CSCF)

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

1. The E-CSCF receives all SIP requests from the I-CSCF. The P-CSCF is not applicable in this architecture.
2. The E-CSCF shall always query the LRF for routing instructions (i.e., the PSAP URI) and, potentially, user device location.
3. The E-CSCF connects to NENA i3 PSAPs via an (egress) IBCF. The E-CSCF connects to legacy PSAPs via an IBCF and an LPG.
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 Section 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.
2. (5.11.2 step 1D) Since an LRF is to be used, 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 Section 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 i3 PSAP or a legacy PSAP via an IBCF based on the Route URI received in the Contact header of the 300 Multiple Choices message received from 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, 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 pass any 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 Section 5.11.3, *Use of LRF*, with the following clarifications:

- The E-CSCF shall route 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 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 Section 5.11.2 of 3GPP TS 24.229.
- The E-CSCF shall also follow the procedures adopted in Section 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 that contains a Contact URI parameter of “Route”, it shall populate the outgoing SIP INVITE as shown in section 9.1.1.
    - As described in Section 5.11.3 of 3GPP TS 24.229, if the E-CSCF does not receive a SIP 300 Multiple Choices in response to a 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 Route header of the outgoing SIP INVITE message.

9.1.1 Header Usage

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

Parsing of the 300 Multiple Choices Contact Header

The Contact header in the 300 Multiple Choices response shall contain the Route URI that designates either a legacy or NENA i3 PSAP.

Request Line

On an outgoing initial SIP INVITE toward a legacy PSAP or a NENA i3 PSAP, the E-CSCF shall copy the emergency services 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 Route parameter is returned in the 300 Multiple Choices response to allow the E-CSCF to determine how to route the call. The Route parameter will contain a sip URI (e.g., sip: `psap@st.county.net`).

The E-CSCF will use the Route parameter to create a Route header in the outgoing SIP INVITE and will populate the Route header with the sip URI that was provided in the Route parameter.

Example:

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

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

The LRF procedures are defined in 3GPP TS 24.229 [Ref 2] Sections 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

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.

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 that may have been 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 Header Usage

This Section 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 the Route URI provided by the RDF. The E-CSCF will use this Route header 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 i3 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>
```

9.2.4 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, 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, which in turn, will use this URI rather than the one that the LRF received from the RDF.

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 either the legacy PSAP or a NENA i3 PSAP. In either case, 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 adhere to Section 7.1 of NENA-STA-010.2 [Ref 27] with additions and clarifications noted in this Section. The LNG will operate as an entry point for legacy emergency calls.

The LNG will map CAMA or Feature Group D (FG D) MF signaling, or SS7 parameters into SIP headers based upon the type of signaling on the incoming trunk group. The types of signaling supported are: SS7 wireline, CAMA wireline, FG D wireline, SS7 Wireline Compatibility Mode (WCM) for wireless, CAMA WCM for wireless, FG D for wireless, SS7 Non-Call Associated Signaling (NCAS), CAMA NCAS, and FG D NCAS.

Table 9-1 provides a summary of the signaling mappings that an entry LNG must be capable of performing to support emergency originations from legacy wireline and legacy wireless networks.

Table 9-1: Mapping at LNG

	CdPN	CPN	CN/ANI	GDP	From	To	R-URI	PAI	P-Charge-Info
Legacy Wireline – SS7	911	TN	CN	-	TN	911	sos	TN	CN
Legacy Wireline – MF	911	-	ANI	-	ANI	911	sos	ANI	ANI
Legacy Wireless – WCM-SS7	911	ESRK	CN	-	CBN	911	sos	CBN	CN
Legacy Wireless – WCM-MF	911	-	ESRK	-	CBN	911	sos	CBN	ESRK
Legacy Wireless – NCAS-SS7	911	TN	CN	ESRD/K	TN	911	sos	TN	CN
Legacy Wireless – NCAS-MF	ESRD/K	-	ANI	-	ANI	911	sos	ANI	ANI

Table 9-2 through Table 9-10 provide examples of the mappings that will be performed by an LNG from various types of incoming SS7 and MF signaling to SIP.

9.4.1 SS7 Wireline to SIP Header Mapping Example

Table 9-2 illustrates the mapping from SS7 parameters to the SIP headers sent to the I-CSCF in the outgoing SIP INVITE message for wireline calls. The Called Party Number (CdPN) and Calling Party Number (CPN) parameters are mapped as shown in the table.

Table 9-2: SS7 Wireline to SIP Header Mapping Example

SS7 Parameter	SS7 Example	SIP Header	SIP Example
CPN	3125551234	From	<sip:+13125551234@carrier.example.net;user=phone>

CdPN	911	To	sip:911@carrier.example.com
CPN OLI CPC	3125551234 00 emergency	PAI	<sip:+13125551234@carrier.example.net;user=phone>
NA		Request URI	urn:service:sos

9.4.2 CAMA Wireline to SIP Header Mapping Example

Table 9-3 illustrates the mapping from CAMA MF signaling to SIP headers sent to the I-CSCF in the outgoing SIP INVITE message for wireline calls. The Calling and Called Numbers are mapped as shown in the table. The NPA is populated by the LNG based on the incoming trunk group.

Table 9-3: CAMA MF Wireline to SIP Header Mapping Example

CAMA Signaling	CAMA Example	SIP Header	SIP Example
Calling Number/ ANI	I+7digits 0+5551234	From	<sip:+13125551234@carrier.example.net;user=phone>
Called Number	911	To	sip:911@carrier.example.com
Calling Number/ ANI	I+7digits 0+5551234	PAI	<sip:+13125551234@carrier.example.net;user=phone>
NA		Request URI	urn:service:sos

9.4.3 FG D Wireline to SIP Header Mapping Example

Table 9-4 illustrates the mapping from FG D signaling to SIP headers sent to the I-CSCF in the outgoing SIP INVITE message for wireline calls. The Calling and Called Numbers are mapped as shown in the table.

Table 9-4: FG D MF Wireline to SIP Header Mapping Example

FG D Signaling	CAMA Example	SIP Header	SIP Example
Calling Number	II+10-digits 00+ 3125551234	From	<sip:+13125551234@carrier.example.net;user=phone>
Called Number	911	To	sip:911@carrier.example.com
Calling Number	II+10-digits 00+ 3125551234	PAI	<sip:+13125551234@carrier.example.net;user=phone>
NA		Request URI	urn:service:sos

9.4.4 SS7 Wireline Compatibility Mode to SIP Header Mapping Example

Table 9-5 illustrates the mapping from SS7 parameters to SIP headers sent to the I-CSCF in the outgoing SIP INVITE message for Wireline Compatibility Mode (WCM) wireless calls. The Called Party Number is mapped as shown in the table. The content of the Calling Party Number parameter (i.e., the ESRK) is used to query the MPC/GMLC. The callback number received in the response from the MPC/GMLC is used to populate the From and PAI headers.

Table 9-5: SS7 WCM to SIP Header Mapping Example

SS7 Parameter	SS7 Example	SIP Header	SIP Example
CPN (ESRK)	7185111234	From (CBN obtained from MPC/GMLC)	<sip:+13125551234@carrier.example.net;user=phone>
CdPN	911	To	sip:911@carrier.example.com
CPN (ESRK) OLI CPC	7185111234 00 emergency	PAI (CBN obtained from MPC/GMLC)	<sip:+13125551234@carrier.example.net;user=phone>
NA		Request URI	urn:service:sos

9.4.5 CAMA MF WCM to SIP Header Mapping Example

Table 9-6 illustrates the mapping from CAMA MF signaling to SIP headers sent to the I-CSCF in the outgoing SIP INVITE message for Wireline Compatibility Mode wireless calls. The Called Party Number is mapped as shown in the table. The content of the MF Calling Number/ANI (i.e., the ESRK) is used to query the MPC/GMLC. The callback number received in the response from the MPC/GMLC is used to populate the From and PAI headers. The NPA is populated by the LNG based on the incoming trunk group.

Table 9-6: CAMA MF WCM to SIP Header Mapping Example

CAMA Signaling	CAMA Example	SIP Header	SIP Example
Calling Number/ ANI (ESRK)	I+7digits 0+5111234	From (CBN obtained from MPC/GMLC)	<sip:+13125551234@carrier.example.net;user=phone>
Called Number	911	To	sip:911@example.com
Calling Number/ ANI (ESRK)	I+7digits 0+5111234	PAI (CBN obtained from MPC/GMLC)	<sip:+13125551234@carrier.example.net;user=phone>
NA		Request URI	urn:service:sos

9.4.6 FG D MF WCM to SIP Header Mapping Example

Table 9-7 illustrates the mapping from FG D MF signaling to SIP headers sent to the I-CSCF in the outgoing SIP INVITE message for Wireline Compatibility Mode wireless calls. The Called Party Number is mapped as shown in the table. The content of the MF Calling Number/ANI (i.e., the ESRK) is used to query the MPC/GMLC. The callback number received in the response from the MPC/GMLC is used to populate the From and PAI headers.

Table 9-7: FG D MF WCM to SIP Header Mapping Example

FG D Signaling	FG-D Example	SIP Header	SIP Example
Calling Number/ ANI (ESRK)	II+10-digits 00+7185111234	From (CBN obtained from MPC/GMLC)	<sip:+13125551234@carrier.example.net;user=phone>
Called Number	911	To	sip:911@example.com
Calling Number/ ANI (ESRK)	II+10-digits 00+7185111234	PAI (CBN obtained from MPC/GMLC)	<sip:+13125551234@carrier.example.net;user=phone>
NA		Request URI	urn:service:sos

9.4.7 SS7 NCAS to SIP Header Mapping Example

Table 9-8 illustrates the mapping from SS7 parameters to SIP headers sent to the I-CSCF in the outgoing SIP INVITE message for NCAS wireless calls. The Called Party Number and Calling Party Number parameters are mapped as shown in the table.

Table 9-8: SS7 NCAS to SIP Header Mapping Example

SS7 Parameter	SS7 Example	SIP Header	SIP Example
CPN OLI CPC	3125554567 62 emergency	From	<sip:+13125554567@carrier.example.net;user=phone>
CdPN	911	To	sip:911@example.com
CPN OLI CPC	3125554567 62 emergency	PAI	<sip:+13125554567@carrier.example.net;user=phone>
NA		Request URI	urn:service:sos

9.4.8 CAMA MF NCAS to SIP Header Mapping Example

Table 9-9 illustrates the mapping from CAMA MF NCAS signaling to SIP headers sent to the I-CSCF in the outgoing SIP INVITE message for NCAS wireless calls. The Called Number and Calling Number are mapped as shown in the table. The NPA is populated by the LNG based on the incoming trunk group.

Table 9-9: CAMA MF NCAS to SIP Header Mapping Example

MF NCAS Signaling	MF NCAS Example	SIP Header	SIP Example
Calling Number/ANI	I + 7 Digits 0+5554567	From	<sip:+13125554567@carrier.example.net;user=phone>
NA		To	sip:911@carrier.example.com
Calling Number/ ANI	I + 7 Digits 0+5554567	PAI	<sip:+13125554567@carrier.example.net;user=phone>
NA		Request URI	urn:service:sos

9.4.9 FG D MF NCAS to SIP Header Mapping Example

Table 9-10 illustrates the mapping from FG D MF NCAS signaling to SIP headers sent to the I-CSCF in the outgoing SIP INVITE message for NCAS wireless calls. The Called Number and Calling Number are mapped as shown in the table.

Table 9-10: FG D MF NCAS to SIP Header Mapping Example

MF NCAS Signaling	MF NCAS Example	SIP Header	SIP Example
Calling Number/ANI	II + 10-digits 62+3125554567	From	<sip:+13125554567@carrier.example.net;user=phone>
NA		To	sip:911@carrier.example.com
Calling Number/ ANI	II + 10-digits 62+3125554567	PAI	<sip:+13125554567@carrier.example.net;user=phone>
NA		Request URI	urn:service:sos

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. Traditional MF and E-MF interfaces to legacy PSAPs assume that callback information signaled to a PSAP will be in the form of a 7/10-digit North American Numbering Plan (NANP) number. If the incoming SIP signaling contains callback information that is not in the form of (or easily converted to) a 10-digit NANP number, the LPG will perform a mapping from the non-NANP callback information to a locally-significant digit string (i.e., a pseudo Automatic Number Identification [pANI] of the form NPA/NPD-511-XXXX) that can be delivered to the legacy PSAP via traditional MF or E-MF signaling, with an appropriate NPA and II digits, or NPD.

Likewise, location information associated with an emergency call origination that is delivered to the LPG 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 LPG will therefore be expected to map this information to a location key (i.e., pANI) that is in the form of a NANP number (i.e., NPA/NPD-511-XXXX, with an appropriate NPA and II digits, or NPD) so that it can be delivered to legacy PSAPs that are interconnected to the LPG.

The LPG will also 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.

There is additional information beyond just the callback number and location information that may be included in an ALI response. The LPG will use Additional Data structures to populate other fields in the ALI response. 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 28] 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".

The LPG will interpret a switch-hook flash from a legacy PSAP as a request for emergency call transfer. The LPG will return a second dial tone to the legacy PSAP in response to the "flash" signal. The LPG will then be responsible for interpreting incoming DTMF signaling from the legacy PSAP to determine the transfer-to party for the call. Based on the information provided via DTMF, the LPG will identify the transfer-to party as follows:

- If the incoming DTMF signaling in the transfer request from the legacy PSAP consists of a 7/10 digit number, the LPG will use this information to identify the transfer-to party for the call.
- If the incoming DTMF signaling in the transfer request from the legacy PSAP consists of "# + 4 digits", the LPG will add the appropriate NPA-NXX digits at the beginning of the 4-digit string, and use this information to identify the transfer-to party for the call.
- If the LPG receives a code of the form "*XX" in the DTMF signaling from the legacy PSAP, the LPG will do one of the following, based on trunk group provisioning:
    - The LPG will map the received *XX code to a static URI that is associated with the transfer-to party.
    - The LPG will map the received *XX code to a service URN, and query an ECRF using this service URN and the location information received with the call. The LPG will then use the URI returned in the response from the ECRF to identify the transfer-to party.

Having identified the transfer-to party, the LPG will follow the procedures specified in Section 8.8 for transferring the emergency call.

The LPG will 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 will include a pointer/reference to an Emergency Incident Data Document (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 i3 PSAP or serving LPG 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.

Also, 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 have to first send a dereference request to obtain the information "by-value".

See Section 7.2 of NENA-STA-010.2 [Ref 27] for further details related to LPG procedures and protocols.

9.6 Procedures at the IBCF

The IBCF shall adhere to Sections 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 33].

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 transfer procedures described in Section 8.8.1.1, 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.

The entry point IBCF shall not delete any P headers.

9.6.2 Exit Point IBCF

The exit point IBCF shall use the Route header to determine the NENA i3 PSAP or the LPG. 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 section 9.5 for further details related to the LPG.)

In support of the transfer procedures described in Section 8.8.1.1, 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 transfer procedures described in Section 8.8.1.2, the exit point IBCF will act as a signaling/media plane B2BUA that supports replacement of the Contact header and anchors media.

9.7 Procedures at the I-CSCF

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

The I-CSCF receives emergency requests from the IBCF. The I-CSCF identifies that the incoming call is an 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.

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 Route header-field of the outgoing SIP INVITE.

9.8 Procedures at the Conferencing Application Server (AS)

The conferencing Application Server (AS) shall adhere to Section 5.2.3 in 3GPP TS 24.147 [Ref 11] with additions and clarifications as noted in this Section.

When the transfer of an emergency call is initiated by a PSAP, the conferencing AS will receive a SIP INVITE message from an I-CSCF that contains a conference factory URI (that is known by/provisioned at the Primary PSAP or LPG) in the Request URI and To headers, and includes a Resource Priority Header set to “esnet.1” to indicate that the session request is associated with the transfer of an emergency call.

In response to the SIP INVITE message, the conferencing AS will interact with an MRFC and return a SIP 183 Session Progress message that includes a Contact header containing the conference URI for the conference that was allocated by the AS/MRFC, and the isfocus feature parameter. The conferencing AS will then return a SIP 200 OK message to establish the media session with the Primary PSAP.

If the conferencing AS subsequently receives a SIP SUBSCRIBE message from the Primary PSAP requesting a subscription to the conference associated with the URI obtained from the Contact header provided in the 180 SESSION PROGRESS message, the conferencing AS will return a SIP NOTIFY message providing subscription status information to the Primary PSAP.

In the context of emergency call transfer, the conferencing AS will receive REFER methods requesting that it invite other parties (e.g., the emergency caller, a Secondary PSAP) to the conference. The REFER method will contain the Conf-ID and a Refer-To header. The Refer-To header may contain a URI with an escaped Replaces header field (e.g., if the REFER is associated with a request to invite an emergency caller to the conference), or the URI associated with the secondary transfer destination (e.g., Secondary PSAP). If the REFER method is associated with a request to invite a Secondary PSAP to the conference, it will also contain an escaped Call-Info header field containing a reference URI that points to the EIDD data structure and a purpose parameter of “eidd”.

The conferencing AS will return a 202 Accepted message in response to the REFER method, and will generate a SIP INVITE message toward the URI identified in the Refer-To header of the received REFER method to invite that party to the conference. If the conferencing AS does not have the capability to route the request toward the Secondary PSAP, it will send the SIP INVITE to the Transit Function for routing. The SIP INVITE message will include the Conf-ID, and a Contact header that contains the conference URI and the isfocus feature parameter. If received in the associated REFER method, the SIP INVITE message generated by the conferencing AS will also contain the Replaces header or the Call-Info header field containing a reference URI that points to the EIDD data structure and a purpose parameter of “eidd”. 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 conferencing AS will also return a NOTIFY message to the Primary PSAP to update the status of the subscription associated with the REFER request.

If the conferencing AS receives a SIP SUBSCRIBE message from another entity that it has invited to the conference (e.g., a Secondary PSAP), it will acknowledge the subscription request and respond with a SIP NOTIFY message containing subscription status information.

Upon receiving a SIP BYE message from any conference participant, the conferencing AS will terminate the connection to that party, and will provide updated status information to all subscribed participants.

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 Section 5.2.2 of 3GPP TS 24.147 [Ref 11].

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 13].

9.11 Procedures at the Transit Function

The conferencing Transit Function (TRF) shall adhere to the procedures described in Section 5.19.1 of 3GPP TS 23.228 [Ref 19] with the clarifications as noted in this section.

When a PSAP initiates the transfer of an emergency call toward a Secondary 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 Secondary PSAP via an IBCF.

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

This normative annex provides the SIP INVITE profile for emergency calls received at the IBCF in the ingress side of the IMS-based NG9-1-1 Emergency Services Network and sent to a NENA i3 PSAP. 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.
- **Send PSAP** – Headers sent to NENA i3 PSAP via the egress IBCF.
- **Recv IBCF** – Headers Received at the ingress IBCF.
- **Reference and Notes** – Reference RFCs and clarifying notes.

Table A-2: SIP INVITE Header Profile

Header	Send PSAP	Recv IBCF	Reference and Notes
Accept	O	O	RFC 3261 [Ref 18] Section 20.1.
Accept-Encoding	O	O	RFC 3261 Section 20. 2.
Accept-Language	O	O	RFC 3261 Section 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 Section 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 Section 20.8.
Call-Info	O	O	RFC 3261 Section 20.9 and Clause 9.1.1 of this standard. If a Call-Info header is received at the ingress IBCF or created by the LNG, it will be passed unaltered through the egress IBCF toward the PSAP.
Contact	M	M	RFC 3261 Section 20.9.
Content-Language	O	O	RFC 3261 Section 20.13.
Content-Length	M	M	RFC 3261 Section 20.14.
Content-Type	M	M	RFC 3261 Section 20.15, RFC 6442 [Ref 15] Section 5.1. The value of “multipart/mixed” MUST be supported. The value of “application/sdp” MUST be supported. The value of “application/pidf+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 Section 20.16.
From	M	M	RFC 3261 Section 20.20.
Geolocation	M	M	RFC 6442 Section 4.1 and Clause 9.1.1 of this standard.
Geolocation-Routing	M	M	RFC 6442 Section 4.2 and Clause 9.1.1 of this standard.
History-Info	O	O	RFC 7044 [Ref 23].
Max-Forwards	M	M	RFC 3261 Section 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 Section 20.24. The version "1.0" value is the default; other values MAY be supported.
P-Access-Network-Info Header	O	O	RFC 3455 [Ref 24] Section 4.4.1.
P-Asserted-Identity	O	O	RFC 3325 [Ref 25] Section 4 and Clause 9.1.1 of this standard.
P-Charging-Vector Header	O	O	RFC 3325 Section 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 Section 20.30.
Reply-To	-	-	RFC 3261 Section 20.31.

Header	Send PSAP	Recv IBCF	Reference and Notes
Require	O	O	RFC 3261 Section 20.32. The option tags “precondition”, “replaces”, and “100rel” MUST be supported.
Resource-Priority	M	O	RFC 4412 [Ref 20], updated by RFC 7134 [Ref 21].
Route	M	O	RFC 3261 Section 20.34 and Section 9.1.1 of this standard.
Supported	M	M	RFC 3261 Section 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 Section 20.39.
Unsupported	O	O	RFC 3261 Section 20.40.
Visa	M	M	RFC 3261 Section 20.42.

Annex B (informative) – Message Examples

This informative Annex provides message examples for various use cases.

B.1 Legacy Fixed Line UE to Traditional Legacy PSAP (Wireline) Example

The following represents an example of a SIP INVITE sent from the LNG to the BCF of the emergency services network for an emergency call originating from a fixed-line UE.

NOTES:

1. INVITE messages between the BCF and I-CSCF, between the I-CSCF and the E-CSCF, and between the E-CSCF and the LRF are the same except for providing the Via headers and the value of the Route header.
2. The INVITE message between the E-CSCF and the LPG (ignoring the BCF) are the same except for providing the Via headers and a Route URI obtained from the Contact header of the 300 Multiple Choices from the LRF.

```
INVITE urn:service:sos SIP/2.0
Via: SIP/2.0/UDP lng.provider.example.net;branch=z9hG4bK77993dd
Route: sip:i-cscf.es-provider.example.net;lr
From: <sip:+13125551234@lng.provider.example.net;user=phone>;tag=23ac
To: sip:911@esnet.example.net
Contact: sip:+13125551234@lng.provider.example.net;user=phone
P-Asserted-Identity: sip:+13125551234@lng.provider.example.net;user=phone
Geolocation: <cid:target-loc@lng.provider.example>
Geolocation-Routing:yes
Call-Info: “urn:nena:uid:callid:a56e556d871:lng.lng-provider”;purpose= nena-
CallId
Call-Info: “urn:nena:uid:incidentid:b34e556d225:lng.lng-provider”;purpose=
nena-IncidentId
Call-Info: <cid:ProviderInfo@lng.provider.example>;
purpose=EmergencyCallData.ProviderInfo
Call-Info: <cid:ServiceInfo@lng.provider.example>;
purpose=EmergencyCallData.ServiceInfo
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@lng.provider.example
[PIDF-LO here]
--boundary1
Content-Type: application/xml
Content-ID: ProviderInfo@lng.provider.example
[Provider Information here]
--boundary1
Content-Type: application/xml
Content-ID: ServiceInfo@lng.provider.example
[Service Information here]
--boundary1--
```

The following represents an example of a 300 Multiple Choices sent from LRF to E-CSCF for an emergency call originated from a fixed-line UE and destined to a legacy PSAP via a LPG.

NOTE:

1. If the emergency request were destined to a NENA i3 PSAP the only change would be the IP address of the NENA i3 PSAP in the Contact header.

```
SIP/2.0 300 Multiple Choices
Via: SIP/2.0/UDP e-cscf.es-provider.example.net;branch=z9hG4bKk9eb5810k
Via: SIP/2.0/UDP i-cscf.es-provider.example.net;branch=z9hG4bK776asdhds
Via: SIP/2.0/UDP bcf.es-provider.example.net; branch=z9hG4bKdko11i5i71 Via:
SIP/2.0/UDP lng.provider.example.net; branch=z9hG4bK77993dd
From: <sip:+13125551234@lng-provider.example.net;user=phone>;tag=23ac>
To: urn:service:sos
Call-ID: 19dn30
CSeq: 1 INVITE
Contact:<sip:psap.st.county.lpg@provider.example.net>
Content-Length: 0
```

B.2 Legacy Mobile UE to Traditional Legacy PSAP (Wireless) Example

Emergency call requests from a legacy mobile UE will enter the emergency services network providing a location reference for the LbyR scenario. The SIP will appear as in the B1 example with a different Geolocation header format as shown below. Otherwise the format is the same as shown in the B1 example.

```
Geolocation: <https:lng.provider.example/ajm4392>
Geolocation-Routing:yes
```

The 300 Multiple Choices response is the same as shown in the B1 example.

B.3 Fixed Line IP OSP UE to Traditional Legacy PSAP Example

In this example the UE resides within an IP OSP network capable of providing the LbyV in the call request. The B1 example applies with the exceptions noted below.

1. The nena-CallId and nena-IncidentId are not provided by the OSP network.
2. The Via, Geolocation and other header examples represent the OSP network rather than the LNG.

Via example:

```
Via: SIP/2.0/UDP bcf.osp.provider.example.net; branch=z9hG4bK77993dd
```

Geolocation example:

```
Geolocation: <cid:target-loc@osp.provider.example>
```

The 300 Multiple Choices response is the same as shown in the B1 example.

B.4 Mobile IP OSP UE to Traditional Legacy PSAP Example

In this example the UE resides within an IP OSP network capable of providing the LbyR in the call request. The B2 example applies with the exceptions noted below.

1. The nena-CallId and nena-IncidentId are not provided by the OSP network.
2. The Via, Geolocation and other header examples represent the OSP network rather than the LNG.

Via example:

```
Via: SIP/2.0/UDP bcf.osp.provider.example.net; branch=z9hG4bK77993dd
```

Geolocation example:

```
Geolocation: <https:osp.provider.example/ajm4392>
```

The 300 Multiple Choices response is the same as shown in the B1 example.