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Technical Report

3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; Extended support of IP Multimedia Subsystem (IMS) emergency sessions (Release 9)

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Foreword

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Introduction

The solution for support of IMS Emergency calls defined for Rel-7 in TS 23.167 [2] has a number of limitations and potential limitations. These include restriction only to certain IP-CANs, restriction only to cases where at least part of the IP-CAN and visited IMS belong to the same operator, possible non-alignment with the various allowed IETF solutions and possible performance limitation. While it is possible that none of these limitations will be significant for some deployments of this service, it is not certain that this will apply to all deployments. Therefore it has been decided to evaluate both the service defined in TS 23.167 [2] and possible extensions that might overcome these limitations.

1 Scope

The present document provides a study investigating possible limitations of the solution for IMS emergency calls defined for Rel-7 in TS 23.167 [2], as well as possible extensions of that solution to reduce or eliminate some or all of the identified limitations.

The study item is expected mainly to concern IMS although some aspects of IP-CAN support may also be included. The study item has the following objectives

- Evaluate the feasibility of supporting IMS emergency calls for combinations of IP access network A and IMS core network B not supported in Rel-7 including but not limited to the following cases:
    - A is any IP access network and B is the home 3GPP compliant IMS network for any emergency calling UE with adequate security credentials
    - A is any IP access network and B is a visited 3GPP compliant IMS network for any emergency calling roaming UE with adequate security credentials

  Additional user cases may also be proposed and evaluated during the SI if deemed applicable.
- Evaluate other enhancements to the solution for IMS emergency calls in Release 7 that may improve performance and/or reduce complexity
- Evaluate the feasibility of better aligning the solution in TS 23.167 [2] with applicable IETF standards and draft standards (e.g. from the Ecrit and Geopriv working groups)
- Any enhancement to the support of IMS emergency calls shall remain backward compatible to the solution in Rel-7 from the perspective of the UE and any 3GPP network element. Furthermore, any enhancement should be based on the solution in Rel-7 and should avoid unnecessarily adding new network entities, protocols and interfaces and moving existing functions from one entity to another.

The study item is expected to enable SA WG2 to decide which of the above objectives if any may be worth supporting in Rel-8 and which extensions to the current solution would then be appropriate.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TS 23.167: "IP Multimedia Subsystem (IMS) emergency sessions".

[3] IETF draft-ietf-ecrit-framework-05: "Framework for Emergency Calling using Internet Multimedia".

[4] IETF draft-ietf-ecrit-phonebcp-04: "Best Current Practice for Communications Services in support of Emergency Calling".

[5] IETF draft-ietf-sip-location-conveyance-09: "Location Conveyance for the Session Initiation Protocol".

[6] IETF RFC 4119: "A Presence-based GEOPRIV Location Object Format".

[7] IETF RFC 3856: "A Presence Event Package for the Session Initiation Protocol (SIP)".

[8] IETF draft-ietf-geopriv-http-location-delivery-05: "HTTP Enabled Location Delivery (HELD)".

[9] IETF draft-winterbottom-geopriv-deref-protocol-00: "An HTTPS Location Dereferencing Protocol Using HELD".

[10] ANSI/TIA-1057: "Link Layer Discovery Protocol – Media Endpoint Discovery".

[11] IETF RFC 3825: "Dynamic Host Configuration Protocol Option for Coordinate-based Location Configuration Information".

[12] IETF RFC 4676: "Dynamic Host Configuration Protocol (DHCPv4 and DHCPv6) Option for Civic Addresses Configuration Information".

[13] 3GPP TS 23.271: "Functional stage 2 description of Location Services (LCS)".

[14] IETF RFC 5222: "LoST: A Location-to-Service Translation Protocol".

[15] 3GPP TS 23.401: "General Packet Radio Service (GPRS) enhancements for Evolved Universal Terrestrial Radio Access Network (E-UTRAN) access".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in TR 21.905 [1] and TS 23.167 [2] apply.

3.3 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [1], TS 23.167 [2] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [1] or TS 23.167 [2].

CP	Control Plane
DHCP	Dynamic Host Configuration Protocol
E-SLP	Emergency SLP
HELD	HTTP Enabled Location Delivery
LIS	Location Information Server
LLDP-MED	Link Layer Discovery Protocol – Media Endpoint Discovery
SLP	SUPL Location Platform
SUPL	Secure User Plane Location
UP	User Plane
V-SLP	Visited SLP

4 Overall Requirements

Editor's Note: This clause will expand upon the objectives listed in clause 1.

4.1 Solution Characteristics

It is intended to extend the solution currently defined in Rel-7 so that it can support, as far as possible and within the limitations defined in clause 1 above, any IP based emergency call made from any access as long as both the network providing emergency call handling and the UE are 3GPP IMS compliant. Preferred characteristics of this extended solution are listed below. Some of these preferences (e.g. (1)) could be considered as requirements.

1) Support existing interfaces to a PSAP accessed via the PSTN.

2) Support a single interface to a PSAP accessed via IP from a call perspective and a single interface from a location access perspective. Variants of either single interface may be permitted (e.g. needed to support different regional requirements) although it is preferred to subsume all variants within a single standard in each case. If this is not possible, a single call related standard and a single location related standard should be the goal for each world region.

3) Make use of existing OMA and IETF standards where possible and appropriate for new protocols, network elements and signalling objects – as a preference to creating new 3GPP definitions.

4) Minimize the number of different location solutions and location related network elements and protocols that need to be supported (on the network as opposed to PSAP side) subject to attaining the various other requirements defined here.

5) Support reduced call establishment delay through elimination or reduction of potential sources of high delay such as interaction with a home network (e.g. to support registration and multiple registration attempts) and location retrieval (e.g. for routing purposes).

6) Use a single interface between the serving IMS network and the IP-CAN from a call perspective and a single interface from a location access perspective that can be reused for any IP-CAN (e.g. any wireless access network) – or at least for as many IP-CAN types as possible.

7) Use a single interface between the serving IMS network and the UE from a call perspective and a single interface from a location access perspective that is applicable for any IP-CAN (e.g. any wireless access network) – or at least for as many IP-CAN types as possible.

5 Architectural Requirements and Considerations

Editor's Note: This clause will provide a common foundation and set of common denominators for the architectural alternatives to be considered in clause 6.

5.1 Basic Assumptions

The following assumptions are made regarding the architecture for any extended solution for IMS emergency calls.

1) The IMS network architecture in TS 23.167 [2] will be the basis for supporting extended capabilities.

2) Additional types of IP-CAN may be supported if there is no impact to the IMS network architecture and if any signalling changes (e.g. new SIP parameters or parameter values) are backward compatible.

5.2 Architectural Requirements

5.2.1 Reference Architecture

Figure 5.2.1-1 shows a simplified reference architecture that is consistent with both the solution in Rel-7 and the preferred characteristics of an extended solution listed in clause 4.1.

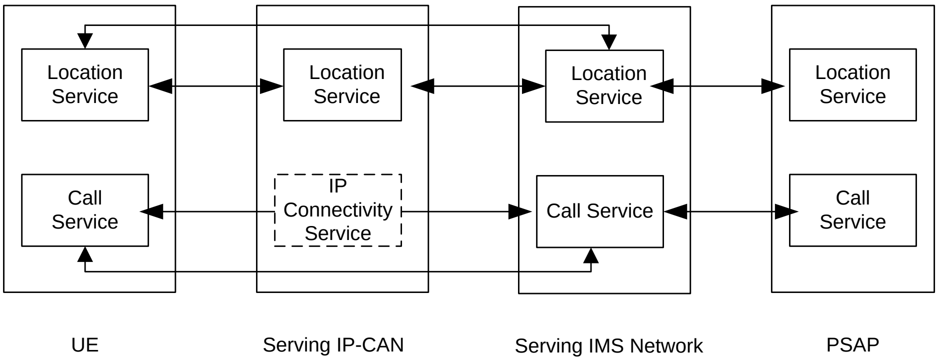

Figure 5.2.1-1: Reference Architecture

Some possible example constituents for some of the service entities shown in the Figure are shown in Table 5.2.1-1 for different types of IP-CAN.

Table 5.2.1-1: Some Service Components in Figure 5.2.1-1

Type of IP-CAN	IP-CAN IP connectivity service	IMS Call service	IP-CAN Location Service	IMS Location Service
GPRS (Rel-8)	GERAN or UTRAN, SGSN, GGSN	P-CSCF, E-CSCF	With a CP solution: SGSN, GERAN or UTRAN, SMLC With a UP solution: V-SLP or null	With a CP solution: LRF, GMLC With a UP solution: LRF, E-SLP
I-WLAN	WLAN, WAG, PDG, AAA server	P-CSCF, E-CSCF	V-SLP or DHCP server	LRF, E-SLP
WLAN direct IP access	WLAN, AAA server	P-CSCF, E-CSCF	V-SLP or DHCP server	LRF, E-SLP

5.2.2 IMS Network

Figure 5.2.2-1 shows the IMS network architecture defined in TS 23.167 [2] with some potential extension to show possible LRF interaction with the IP-CAN and/or UE as implied by Figure 5.2.1-1. Interfaces and network elements shown in heavier font in this figure should be easier to extend and enhance without violating the backward compatibility requirement since the associated interactions and functions are either not completely defined in Rel-7 or are both undefined (or only partially defined) and outside the scope of 3GPP. All of these interfaces and network elements relate to support of location. The rest of the figure (in lighter font) relates to support of registration, call establishment and call back and will be more subject to the backward compatibility requirement.

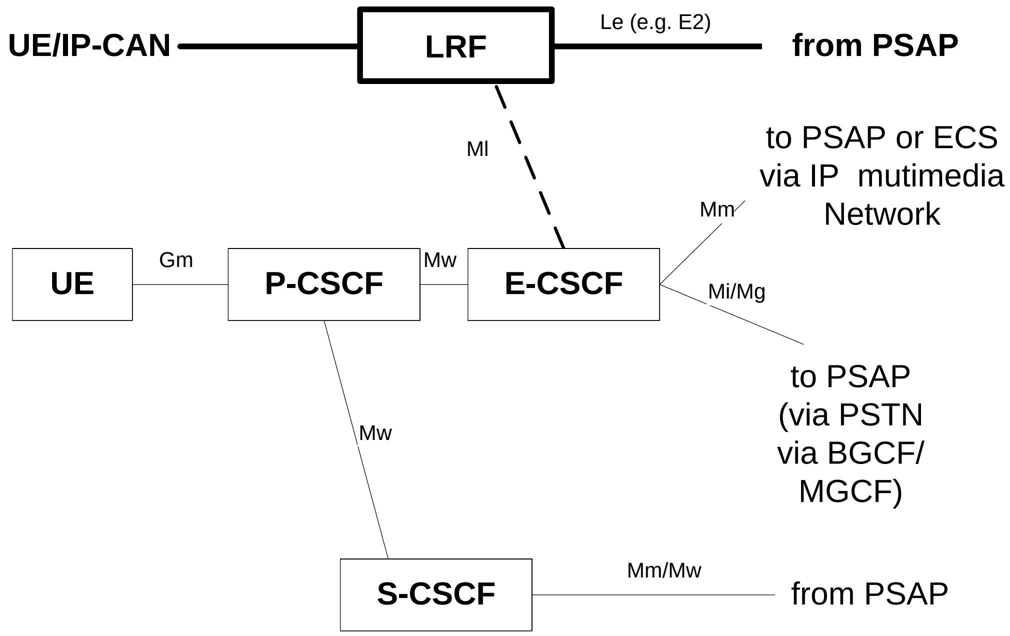

Figure 5.2.2-1: IMS Network Architecture

5.2.3 IP-CAN

The following simple definition of an IP-CAN is given in TS 23.167 [2]:

> **P-Connectivity Access Network (IP-CAN):** The collection of network entities and interfaces that provides the underlying IP transport connectivity between the UE and the IMS entities**.** An example of an "IP-Connectivity Access Network" is I-WLAN.

That this definition is more complex than it seems is shown by the following possible attributes of an IP-CAN in association with the objectives in clause 1:

- may be entirely owned by a single 3GPP operator (e.g. GPRS IP-CAN).
- may be split among multiple operators (e.g. I-WLAN where operator A owns the WLAN AP, operator B owns the WAG and home operator C owns the PDG and AAA server).
- for a non-roaming scenario, may or may not be located or partly located in the H-PLMN.
- for a roaming scenario, may or may not be located or partly located in the V-PLMN.

In order to support such a diversity of IP-CAN types, it is assumed that the principle already implicit in TS 23.167 [2] will be continued whereby call handling support is restricted to the serving IMS network and the role of the IP-CAN is to provide access to the serving IMS network and certain pieces of essential or useful information such as network (or access point) identity and location related information.

5.3 Session Scenarios

5.3.1 Home Network Access to Emergency Services

Figure 5.3.1-1 is a simple adaptation of Figure 5.2.1-1 illustrating home network access to emergency services.

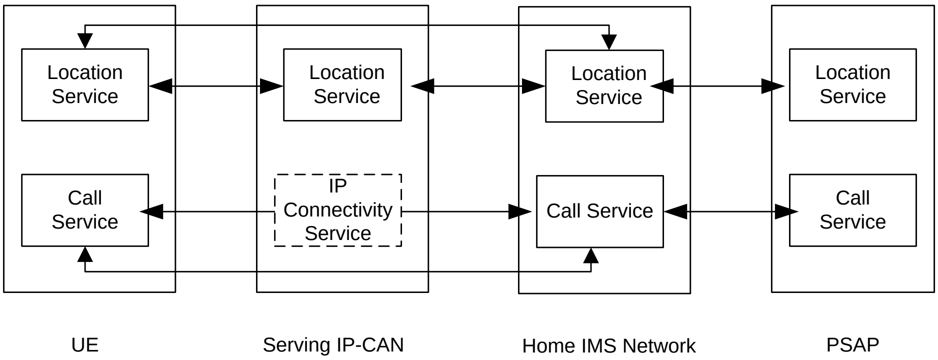

Figure 5.3.1-1: Home Network Access to Emergency Services

The normal assumption in Rel-7 is that Figure 5.3.1-1 applies when the UE is not roaming and thus generally within the geographic area of coverage of the home network if this is 3GPP. However, these assumptions would no longer necessarily apply for an extended solution that enabled the home network operator to provide emergency services access to its subscribers even when roaming (e.g. to assist in cases where a V-PLMN does not support IMS emergency services and to enhance home network IMS services for its roaming subscribers). In particular, while the UE, serving IP-CAN and PSAP may all lie within (or partly within) the same local geographic area the home IMS network may be geographically remote (e.g. in a different state, county or even country).

5.3.2 Visited Network Access to Emergency Services

Figure 5.3.2-1 is a simple adaptation of Figure 5.2.1-1 illustrating visited network access to emergency services (and not showing the Home IMS network role for registration).

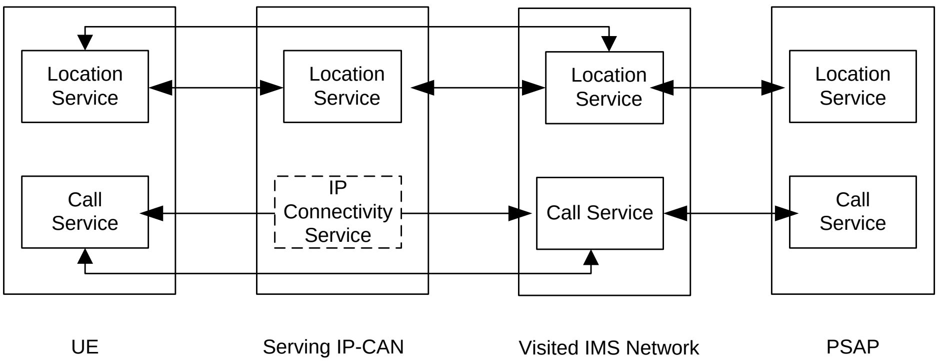

Figure 5.3.2-1: Visited Network Access to Emergency Services

The normal assumption in Rel-7 is that Figure 5.3.2-1 applies when the UE is roaming and thus generally outside the geographic area of coverage of the home network if this is 3GPP but within the coverage area of some other visited 3GPP network. However, these assumptions would no longer necessarily apply for an extended solution that enabled a visited network operator to provide emergency services access over an extended area to roaming subscribers. In particular, while the UE, serving IP-CAN and PSAP may all lie within (or partly within) the same local geographic area the visited IMS network may be geographically remote (e.g. in a different state or county).

6 Architecture Alternatives

Editor's Note: This clause will describe and evaluate alternative architecture additions to the solution in Rel-7 that can support one or more of the objectives listed in clause 1 and requirements listed in clause 4. Some of the alternatives may be complimentary (i.e. capable of being combined) while others may be mutually exclusive.

6.1 IMS Emergency Call Redirection

6.1.1 Objectives

If a subscriber does not have wireless access at the time an emergency call is dialled (e.g. the user has just powered on the phone before dialling) or if the user has access to a data only network without voice call capability (e.g. has internet access via a WLAN) then the user's expectation of a an emergency call succeeding and the legal requirements for some VSP supporting the emergency call will both be significantly lower than if the user is already accessing a voice capable network (e.g. a 3GPP voice capable VPLMN) at the time the emergency call is dialled. This suggests that any extended solution for IMS emergency calls should at least support the latter case in all scenarios, or in as many scenarios as possible.

A major problem is that in many cases, the VSP accessed by the user will not be local to the user's current location. For example, the user may be in a roaming situation and accessing the H-PLMN or some other remote VSP using direct IP access (e.g. from a WLAN or some other data only access network). In that case, the VSP may not be able to establish an emergency call to a suitable local PSAP and there will be no local VSP (e.g. 3GPP VPLMN) already being accessed to fall back to.

Of course, the serving VSP could just reject an attempt to establish an IMS emergency call (e.g. via a 380 alternative service response) leaving the UE to search around for some alternative – e.g. via scanning for VSPs accessible from its current IP-CAN or by performing a radio search for other wireless IP-CANs. But that is hardly a reliable solution and, moreover, the serving VSP may have some strong interest in helping establish an emergency call – not least because as a service to its subscribers, it could be used to increase the VSP's subscriber base and revenue.

This clause and the following one provide two alternative solutions whereby a serving VSP can direct the call to a more suitable local VSP without requiring the UE to perform a new search. With the solution in this clause, the original serving VSP employs a SIP 380 response to provide the UE with the URI of an alternative VSP.

6.1.2 Architectural Details

The solution defined here does not require any change to the existing architecture already defined in TS 23.167 [2]. It just requires that the serving VSP and new VSP to which the call is redirected both support this architecture.

6.1.3 Information Flows

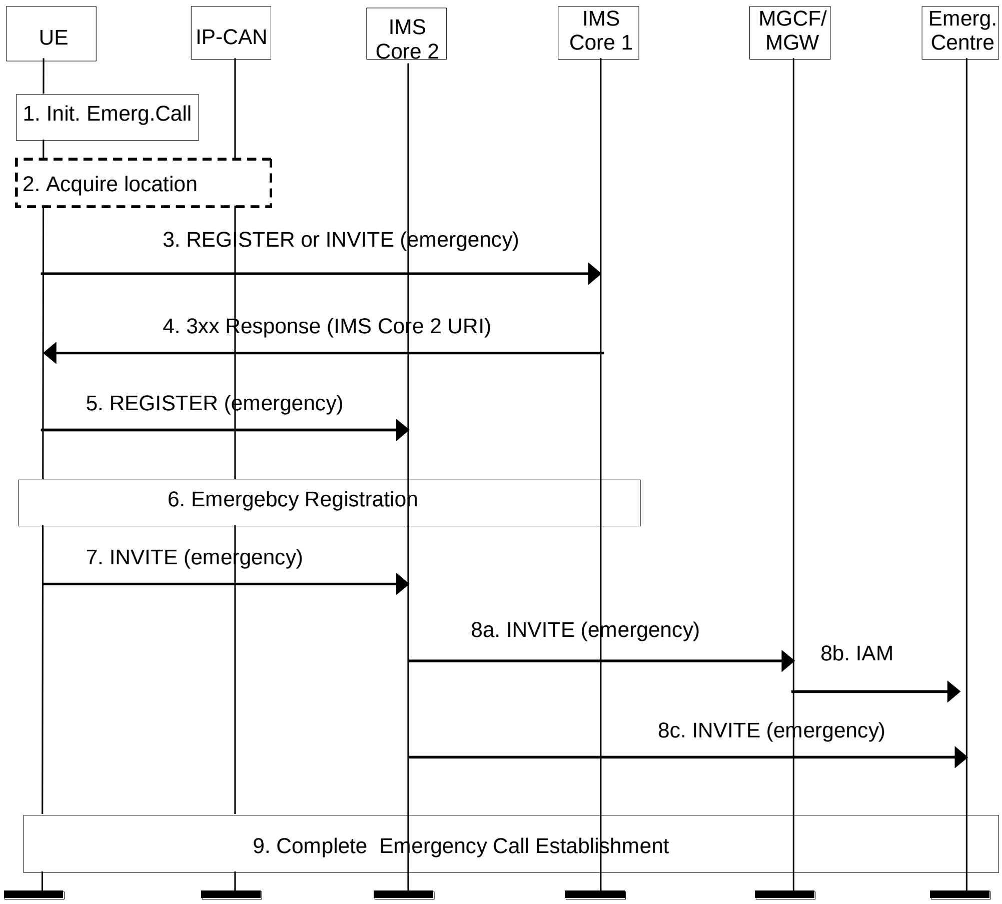

Figure 6.1.3-1: Redirection of an IMS emergency call

1. The user initiates an emergency call.

2. The UE determines its own location or location identifier or obtains location information from the IP-CAN.

3. The UE sends a REGISTER with an emergency indication or an INVITE with an emergency indication to the currently serving IMS core (IMS Core 1). The REGISTER or INVITE should contain any location information that the terminal has. For security reasons, the UE may include location information or at least accurate location information only in an INVITE and not in a REGISTER.

4. The serving IMS Core (e.g. the P-CSCF) may obtain further location information from the IP-CAN and/or UE. The serving IMS Core determines from the location information provided in step 3 and/or from the location information obtained from the IP-CAN and/or UE that the UE is outside the emergency serving area for IMS Core 1. The serving IMS Core returns a 3xx response (e.g. a 380 Alternative Service response) that includes the URI (e.g. IP address or FQDN) of a P-CSCF in an alternative IMS Core (IMS Core 2) – e.g. in the SIP Contact Address header of the 3xx response. The serving IMS Core may include URIs for additional IMS Cores. The provided URIs and their location association might be configured in the serving IMS Core. For some locations, no URIs might be configured, in which case a 3xx (e.g. 380) response not carrying any URI would be returned. The provision of a URI or URIs might be further constrained according to whether the serving IMS Core is the home IMS for the UE (e.g. might only be provided if the serving IMS Core is the home IMS Core) and according to whether reliable location information is available (e.g. might only be provided if the IP-CAN or UE is able to provide reliable location information).

5. The UE sends a REGISTER with an emergency indication to the alternative IMS Core, or one of the alternative IMS Cores, indicated in step 4. The REGISTER should contain any location information that the UE has.

6. If the alternative IMS Core (e.g. a P-CSCF) determines that the UE is outside its own emergency serving area or that an emergency call cannot be supported for other reasons (e.g. no agreement with the UE's home network), it may return a 3xx response carrying one or more URIs for other IMS Cores as in step 4. In that case, the UE may

attempt to use other IMS Core networks in step 5, if these were provided in step 4 or step 6. Otherwise, the alternative IMS Core (e.g. a P-CSCF) continues the emergency registration via the UE's home network. In so doing, the identity of the UE will be authenticated and a secure IP connection will be established with the UE.

7. The UE sends an INVITE with an emergency indication to the alternative IMS core (IMS Core 2). The INVITE should contain any location information that the UE has. The INVITE may be forwarded within the alternative IMS Core – e.g. from a P-CSCF to an E-CSCF – and additional location information may be obtained (e.g.; by an LRF).

8. The alternative IMS core selects an emergency centre or PSAP based on location information available in step 7.

   8a. The INVITE is sent to an MGCF/MGW,

   8b. The IAM is continued towards the emergency centre or PSAP, or

   8c. The INVITE is sent directly to the emergency centre or PSAP.

9. The emergency call establishment is completed.

6.1.4 Evaluation

The procedure described in clause 6.1.3 is optional and, if supported, impacts the IMS Core and the UE. Impacts to the IMS Core could be restricted to the P-CSCF. The impacts can be backward compatible with Release 7 – at least if a 380 response is used in step 4 of Figure 6.1.3-1. Specifically, if an IMS core does not support this procedure, then an emergency call attempt in step 3 of Figure 6.1.3-1 would probably fail but there would not be any protocol or procedural violations. If the UE supports IMS emergency calls only according to Release 7, the URI(s) provided by the serving IMS Core in step 4 of Figure 6.1.3-1 would be ignored which would mean that the call might not be resent to an alternative IMS core via the current IP-CAN. On the other hand, if a 380 response, which is already part of Release 7, is used in step 4, the UE would be aware of the need to find and register in a local visited network and thus existing release 7 actions could be used to attempt to setup the call. Backward compatibility for other 3xx responses is FFS.

The procedure defined here may not be applicable to a UE that has not yet recognized an emergency call since in that case a pre-Release 7, 380 response may be needed in step 4 of Figure 6.1.3-1 which would not carry any URI.

6.2 IMS Emergency Call Forwarding

6.2.1 Objectives

IMS Emergency call forwarding is an extension to the solution in Release 7 that has the same objectives and rationale as the extension described in clause 6.1. It can be viewed as an alternative solution for these objectives. Instead of redirecting the call back to the UE, the initial serving IMS Core forwards the call to an alternative IMS Core.

6.2.2 Architectural Details

The solution defined here extends the architecture defined in TS 23.167 [2] as shown in the figure below.

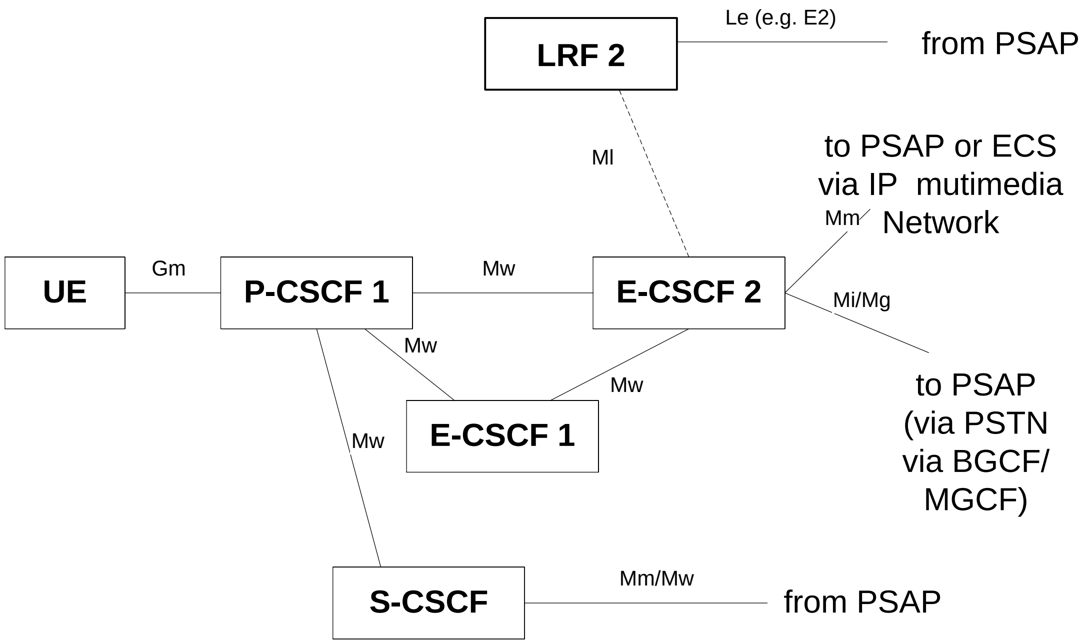

Figure 6.2.2-1: IMS Emergency Call Forwarding Architecture

In figure 6.2.2-1, P-CSCF 1 and E-CSCF 1 belong to IMS Core Network 1 (e.g. the Home IMS Core Network or a currently serving IMS Core Network) while E-CSCF 2 and LRF 2 belong to IMS Core Network 2 – e.g. one supporting IMS emergency calls at the current location of the UE. The interface from P-CSCF 1 to E-CSCF 2 and the interface from E-CSCF 1 to E-CSCF 2 are alternatives only one of which is needed. The S-CSCF would either belong to IMS Core network 1 or to a separate home IMS Core if IMS Core Network 1 is not the UE's home network.

6.2.3 Information Flows

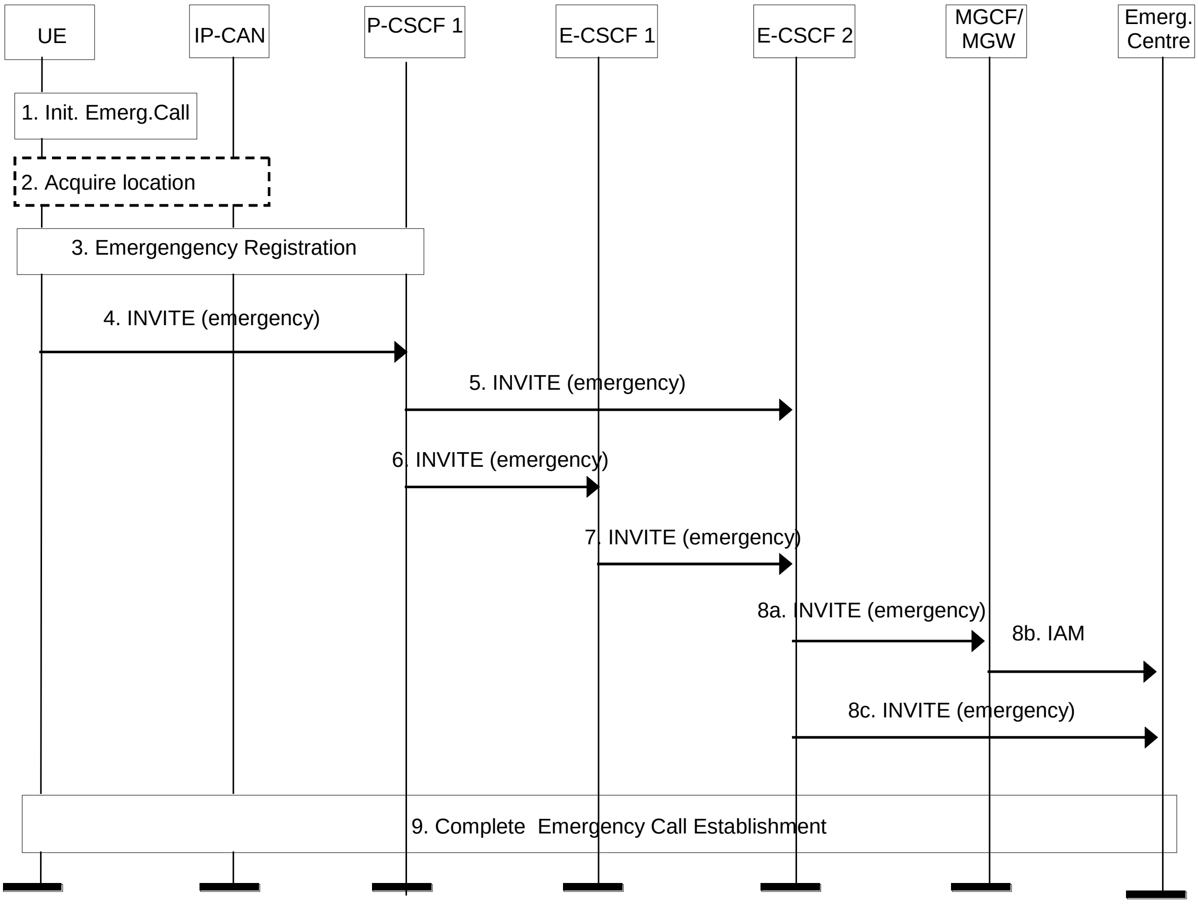

Figure 6.2.3-1: IMS Emergency Call Forwarding

1. The user initiates an emergency call.

2. The UE determines its own location or location identifier or obtains location information from the IP-CAN.

3. The UE may initiate an IMS Emergency Registration with the currently serving IMS Core (IMS Core 1) by sending a REGISTER with an emergency indication to P-CSCF 1. If so, P-CSCF 1 continues the emergency registration with the home IMS network as defined in TS 23.167 [2]. The IMS Emergency registration may not be needed if IMS Core 1 is the home network and the UE assumes it is not roaming.

4. The UE sends an INVITE with an emergency indication to P-CSCF 1. The INVITE should contain any location information that the UE has.

5. Based on the location information received in step 4, P-CSCF 1 may forward the INVITE to E-CSCF 2 in another IMS Core network (IMS Core 2) that supports IMS emergency calls for the current location of the UE. In this case, steps 5 and 6 are omitted.

6. If step 5 is not used, P-CSCF 1 forwards the INVITE to E-CSCF 1 in the same IMS Core network.

7. E-CSCF 1 may verify any location information obtained in step 6 and may obtain additional location information (e.g. from an associated LRF). Based on this location information, E-CSCF 1 forwards the INVITE to E-CSCF 2 in another IMS Core network (IMS Core 2) that supports IMS emergency calls for the current location of the UE. Forwarding in this step or in step 5 requires agreements between the participating IMS Cores (e.g. IMS Core 1 and IMS Core 2) and associated configuration data (e.g. concerning location mapping to different IMS Cores) in each IMS Core. Forwarding is also dependent on location information being available and may not be possible for all IP-CANs.

8. E-CSCF 2 may itself or using an associated LRF verify any location information obtained in step 7, obtain additional location information, determine an emergency centre or PSAP based on this location information and determine correlation information (e.g. an ESQK).

   8a. The INVITE is sent to an MGCF/MGW,

   8b. The IAM is continued towards the emergency centre or PSAP, or

   8c. The INVITE is sent directly to the emergency centre or PSAP.

9. The emergency call establishment is completed.

6.2.4 Local network address resolution

The procedure described in clause 6.2 requires that the IMS Core 1 is able to resolve the address to the serving network (IMS Core 2), which is local for the current UE location.

Following alternatives can be used to resolve the address:

1. P-CSCF or E-CSCF in home IMS Core use the MCC and MNC of the access network to determine the E-CSCF of the IMS Core 2. MCC and MNC are sent by the UE in the P-access-network-info header.

2. The UE obtains the FQDN of the access network from the DHCP server. UE attaches the FQDN to the emergency session request. The FQDN refers to the entry point of the IMS Core network.

   This alternative assumes the UE has obtained the IP address from the local access network. This is not always the case, the IP anchoring point (e.g. PDG in TS 23.401 [15]) may be also in the home network, when the UE is roaming.

3. When the home E-CSCF uses the home LRF to obtain the location of the UE, the home LRF uses the Lr reference point as described in TS 23.271 [13] to obtain the location of the UE from the visited LRF. The visited LRF returns the address of the network serving the current location of the UE. The address is returned to the home E-CSCF, which then is used to route the emergency session to this address.

4. UE is aware of its location, and obtains the Service URL to the serving network as described in LoST in RFC 5222 [14]. UE sends the address in the emergency service request to the home E-CSCF. Home E-CSCF routes the session request to this address.

NOTE: There are potential issues with some or all of the above address resolution mechanisms and further study would be required.

6.2.5 Evaluation

The procedure described in clause 6.2.3 is optional and, if supported, adds impacts to IMS Core 1, However, the procedure is transparent to the UE, to the PSAP and can be transparent to IMS Core 2 provided IMS Core 2 is configured to receive IMS emergency calls from IMS Core 1 (e.g. by maintaining secure IP connections between the communicating entities at all times or by allowing such secure connections to be established as needed dynamically). Impacts to IMS Core 1 could be restricted to just the P-CSCF or to just the E-CSCF depending on whether the P-CSCF or the E-CSCF forwards the call to IMS Core 2 in Figure 6.2.3-1. To avoid impact to a P-CSCF, it may be preferred to retain only the E-CSCF to IMS Core 2 interface alternative and not allow the alternative of forwarding from a P-CSCF. As the UE will only be registered via IMS Core 1, a trust relationship should exist between IMS Core 1 and IMS core 2 such that IMS Core 2 can assume that any UE identity and call back URI provided by IMS Core 1 in step 5 or step 7 of Figure 6.2.3-1 is already authenticated. The impacts should be backward compatible with Release 7 since only IMS Core Network 1 is impacted.

Besides enabling support of IMS emergency calls outside the normal coverage area of a network (IMS Core 1 in Figure 6.2.3-1), the procedure also enables an IMS Core Network to support IMS Emergency Calls for its users when it does not possess all the necessary entities (e.g. if there is no E-CSCF and LRF) - by forwarding all IMS Emergency calls from the P-CSCF to one E-CSCF or to several alternative E-CSCFs in other networks.

The procedure defined here is applicable to a UE that has not recognized an emergency call since the forwarding can be transparent to the UE.

The procedure defined here is not applicable internationally - i.e. in the case that IMS Core 1 and IMS Core 2 belong to 2 different countries - except if agreements exist. This may be due to regulatory constraints (e.g. on forwarding an emergency call to another country) and/or due to technical restrictions related to forwarding between SIP proxies in different countries. Forwarding of emergency calls may also not be possible due to (legal) liability uncertainties between the operators involved. The extent of this restriction and its possible resolution are FFS.

6.3 Enhanced Location Support

6.3.1 Objectives

The current solution for IMS Emergency calls in TS 23.167 [2] explicitly references and allows use of the 3GPP Control plane location solution and OMA SUPL but other possible location solutions are not explicitly supported. To improve on this, it would be useful to extend the current procedures to allow use of other solutions. While such other solutions might not be defined by 3GPP and might not even be defined by some other body until later, having an extended 3GPP solution that allowed for such other location solutions could be useful to operators and vendors and could help avoid a situation where a deployed solution did not exactly fit within the 3GPP definition.

6.3.2 Architectural Details

Architectural details are outside the scope of 3GPP.

6.3.3 Information Flows

Below is the current description of location support from clause 7.6.1 of TS 23.167 [2] with proposed changes to it shown in bold italic.

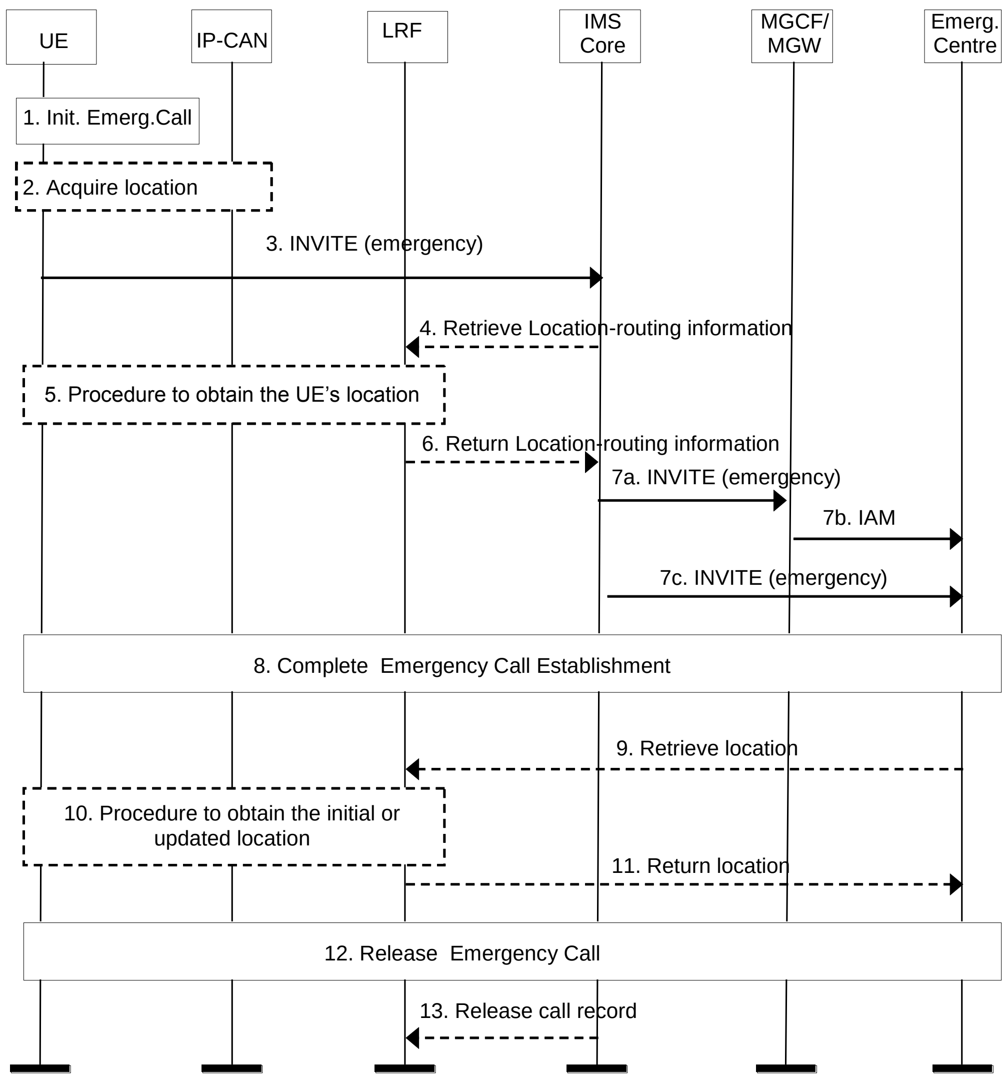

Figure 6.3.3-1: Handling of location information in IMS emergency calls

1. The user initiates an emergency call.

2. The UE determines its own location or location identifier if possible. If the UE is not able to determine its own location, the UE may, if capable, request its location information from the IP-CAN, if that is supported for the used IP-CAN. If applicable, the IP-CAN delivers to the UE the UE's geographical location information and/or the location identifier.

3. The UE sends an INVITE with an emergency indication to the IMS core. The INVITE should contain any location information that the terminal has. The location information may be geographical location information or a location identifier, which is dependant upon the access network technology. In case the UE is not able to provide any location information, the IMS core may seek to determine the UE's location from the LRF as described below. The INVITE may optionally contain information concerning the location solutions and position methods supported by the UE.

NOTE: the location solutions and position methods conveyed in the INVITE and the means of inclusion in the INVITE are outside the scope of this specification.

4. If the location information provided in step 3 is trusted and sufficient to determine the correct PSAP, the procedure continues from step 7 onwards. If the location information is insufficient or if the IMS core requires emergency routing information, or if the IMS core is required to validate the location information, or if the IMS core is required to map the location identifier received from the UE into the corresponding geographical location information, the IMS core sends a location request to the LRF. The request shall include information identifying the IP-CAN and the UE and may include means to access the UE (e.g. UE's IP address). The request shall also include any location information provided by the UE in step 2. The request may optionally include any information concerning the location solutions and position methods supported by the UE.

5. The LRF may already have the information requested by IMS core or LRF may request the UE's location information. The means to obtain the location information may differ depending on the access technology the UE is using to access the IMS. ***In general, the LRF may interact with the IP-CAN and/or the UE to obtain location information. In the case of IP-CAN interaction, the LRF may communicate with a location server in the IP-CAN (e.g. a GMLC, an OMA SUPL SLP or some other server) or may communicate with an entity supporting UE IP connectivity (e.g. an SGSN). This interaction may or may not be defined by 3GPP. One example of a non-3GPP solution is OMA SUPL*** defined in OMA AD SUPL: "Secure User Plane Location Architecture", OMA TS ULP: "User Plane Location Protocol". ***This solution*** may be used if supported by the terminal and if it is possible to establish a user plane connection between the UE and the SUPL server. Information provided in step 4 concerning the location solutions and position methods supported by the UE may optionally be used by the LRF to help determine the means to obtain the location information.

   The LRF may invoke an RDF to convert the location information received in step 4 or obtained in step 5 into PSAP routing information, but LRF's interactions with RDF are out of scope of the present specification. The LRF may store the location information, but only for a defined limited time in certain regions, according to regional requirements.

6. The LRF sends the location information and/or the routing information to the IMS core. The LRF may also return correlation information (e.g. ESQK) identifying itself and any record stored in step 5.

7. The IMS core uses the routing information provided in step 6 or selects an emergency centre or PSAP based on location information provided in step 3 or 6 and sends the request including the location information and any correlation information and possibly location information source, e.g., positioning method that was used to obtain the location information to the emergency centre or PSAP.

   7a. The INVITE is sent to an MGCF/MGW,

   7b. The IAM is continued towards the emergency centre or PSAP, or

   7c. The INVITE is sent directly to the emergency centre or PSAP.

8. The emergency call establishment is completed.

9. The PSAP may send a location request to the LRF to get the initial location information for the target UE, or to request LRF to get updated, i.e. current, location information for the target UE. The PSAP may determine the LRF based on the location and/or correlation information received in step 7. The PSAP may also include the correlation information in the request to the LRF.

10. The LRF determines the target UE's location using one of the means listed in step 5 above. The LRF may use the correlation information received in step 9 to retrieve information about the UE that was stored in step 5.

11. The LRF returns the initial or updated location information to the emergency centre or PSAP. As an option for initial location, the LRF may instigate the location step 10 before the request in step 9 is received and may send the initial location to the emergency centre or PSAP either after the request in step 9 is received or before it is received.

12. The emergency call is released.

13. The IMS core may indicate to the LRF that the call is released. The LRF deletes any record stored in step 5.

6.3.4 Evaluation

This extension does not add any new specific impacts and its support by a UE, IP-CAN and LRF would be optional. The main value is to allow vendors and operators the possibility of supporting new location solutions in the future without the need to revisit the basic solution for IMS emergency calls. This is achieved by an explicit broadening of the solution. While it might be claimed that the existing Release 7 solution already supports this extension (and thus what is defined here is really editorial), it is believed that the explicit extension here will be helpful.

6.4 Common Location Access

6.4.1 Objectives

The IETF solution for IP based emergency calls is defined in draft-ietf-ecrit-framework-05 [3] and in draft-ietf-ecrit-phonebcp-04 [5]. This provides access to location for an IP capable PSAP in a different manner to TS 23.167 [2]. With the IETF solution, a location by value or a location by reference would be transferred in a new Geolocation SIP header (defined in draft-ietf-sip-location-conveyance-09 [5]) in a SIP INVITE to the PSAP. A location by value would be transferred in a message body containing an IETF Geopriv pidf-lo (defined in IETF RFC 4119 [6]), which is also the solution enabled by TS 23.167 [2]. A location by reference would be transferred by including a SIP, SIPS, PRES or possibly HELD URI in the Geolocation Header. The URI would refer to the entity – e.g. in the IETF solution a Location Information Server (LIS) – from which a location by value can subsequently be obtained using a differencing procedure. The dereferencing procedure can use the SUBSCRIBE/NOTIFY mechanism defined in IETF RFC 3856 [7] or might possibly use an extension to HELD defined in draft-ietf-geopriv-http-location-delivery-05 [8] and draft-winterbottom-geopriv-deref-protocol-00 [9]. The concept of providing a location by reference URI to a PSAP and supporting dereferencing to obtain a location value is not explicitly defined in TS 23.167 [2]. Instead, TS 23.167 [2] defines the sending of correlation information to a PSAP and the use of correlation information by a PSAP to subsequently retrieve location.

While TS 23.167 [2] is not in direct conflict with the IETF solution, there seems no advantage in being possibly different, since it would be an advantage to the PSAP and possibly to the network to support location delivery and retrieval in the same manner. If that were not the case, the PSAP (and possibly the network) might have to support 2 different solutions and the PSAP would need to know which solution to use.

TS 23.167 [2] can be made compatible with the IETF solution by explicitly defining transfer of a location by reference URI in a SIP INVITE to a PSAP instead of or in addition to a pidf-lo location value. Furthermore, in doing so, there would be no requirement to incorporate other parts of the IETF solution such as a LIS server in the IP-CAN or Location Configuration Protocols like HELD (draft-ietf-geopriv-http-location-delivery-05 [8]), DHCP (IETF RFC 3825 [11] and IETF RFC 4676 [12]) and LLDP-MED (ANSI/TIA-1057 [10]) which seem more suitable for wireline and certain types of WLAN access. Instead, the LRF can itself assign the location URI and ensure that the URI references the LRF and the location or call record for the UE. From the perspective of the PSAP, it will then not make any difference whether the call was originated from IETF conforming networks or 3GPP conforming networks.

Similar reasoning applies to explicitly supporting IETF defined dereferencing procedures between the PSAP and LRF.

6.4.2 Architectural Details

No architectural changes to TS 23.167 [2] are needed.

6.4.3 Information Flows

Detailed information flows could be added to TS 23.167 [2] showing transfer of a location URI and different types of dereferencing procedures between a PSAP and LRF. But these would be essentially informative since the source definitions are provided by IETF already. It is thus proposed to include only the indicated changes below to clause 7.6.1 of TS 23.167 [2] (changes shown in bold italic) which take advantage of being able to reference IETF standards. If needed, further clarification could be added to TS 23.167 [2] (e.g. an informative annex) when the changes were actually submitted.

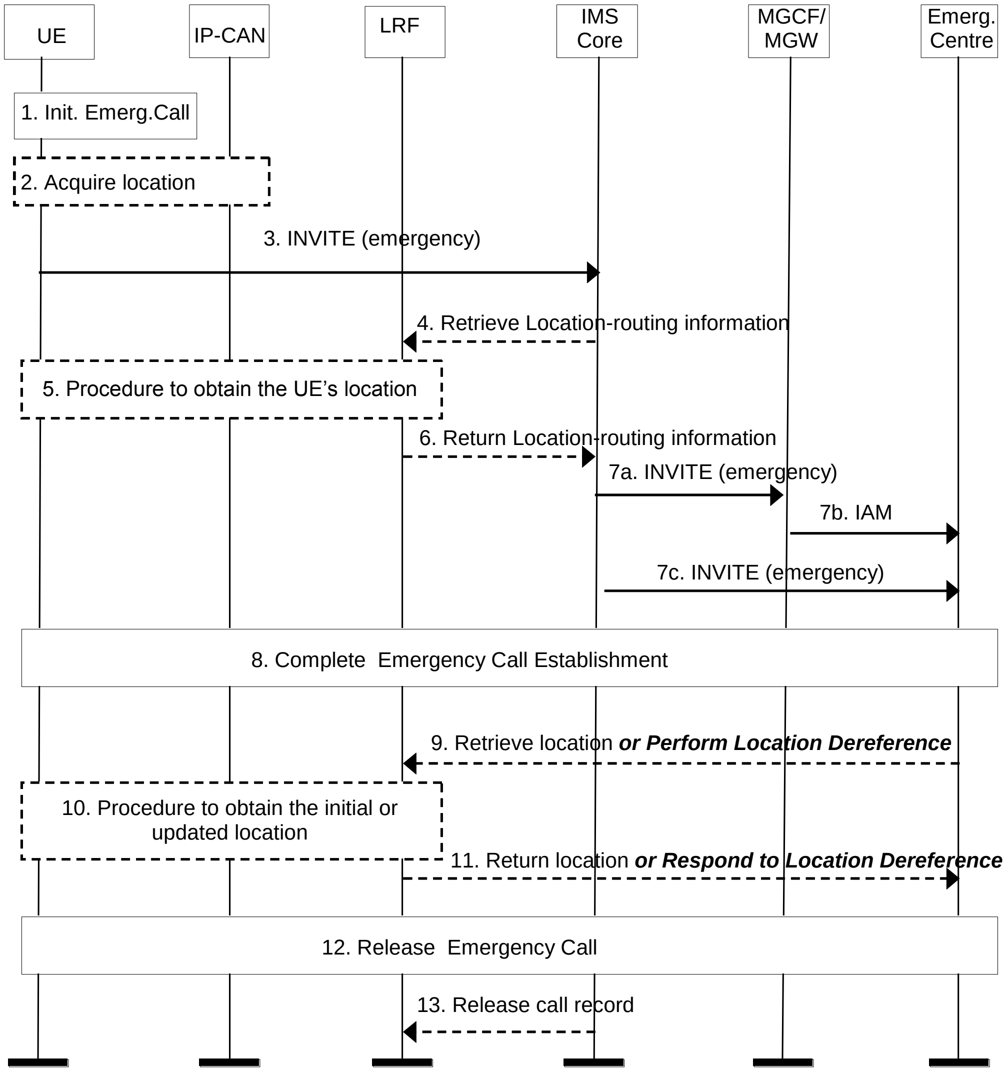

Figure 6.4.3-1: Handling of location information in IMS emergency calls

1. The user initiates an emergency call.

2. The UE determines its own location or location identifier if possible. If the UE is not able to determine its own location, the UE may, if capable, request its location information from the IP-CAN, if that is supported for the used IP-CAN. If applicable, the IP-CAN delivers to the UE the UE's geographical location information and/or the location identifier.

3. The UE sends an INVITE with an emergency indication to the IMS core. The INVITE should contain any location information that the terminal has. The location information may be geographical location information or a location identifier, which is dependant upon the access network technology. In case the UE is not able to provide any location information, the IMS core may seek to determine the UE's location from the LRF as described below. The INVITE may optionally contain information concerning the location solutions and position methods supported by the UE.

NOTE: the location solutions and position methods conveyed in the INVITE and the means of inclusion in the INVITE are outside the scope of this specification.

4. If the location information provided in step 3 is trusted and sufficient to determine the correct PSAP, the procedure continues from step 7 onwards. If the location information is insufficient or if the IMS core requires emergency routing information, or if the IMS core is required to validate the location information, or if the IMS core is required to map the location identifier received from the UE into the corresponding geographical location information, the IMS core sends a location request to the LRF. The request shall include information identifying the IP-CAN and the UE and may include means to access the UE (e.g. UE's IP address). The request shall also include any location information provided by the UE in step 2. The request may optionally include any information concerning the location solutions and position methods supported by the UE.

5. The LRF may already have the information requested by IMS core or LRF may request the UE's location information. The means to obtain the location information may differ depending on the access technology the UE is using to access the IMS. The SUPL procedures defined in OMA AD SUPL: "Secure User Plane Location Architecture" [15], OMA TS ULP: "User Plane Location Protocol" [16], may be used if supported by the terminal and if it is possible to establish a user plane connection between the UE and the SUPL server. Information provided in step 4 concerning the location solutions and position methods supported by the UE may optionally be used by the LRF to help determine the means to obtain the location information.

   The LRF may invoke an RDF to convert the location information received in step 4 or obtained in step 5 into PSAP routing information, but LRF's interactions with RDF are out of scope of the present specification. The LRF may store the location information, but only for a defined limited time in certain regions, according to regional requirements.

6. The LRF sends the location information and/or the routing information to the IMS core. The LRF may also return correlation information (e.g. ESQK) ***or a location URI (e.g. SIP URI, SIPS URI, HELD URI)*** identifying itself and any record stored in step 5. The LRF can determine which location related information to return – e.g. location estimate, location URI, ESQK – according to the capabilities and preferences of the PSAP which may be configured in or otherwise available to the LRF.

7. The IMS core uses the routing information provided in step 6 or selects an emergency centre or PSAP based on location information provided in step 3 or 6 and sends the request including the location information and any correlation information ***or location URI*** and possibly location information source, e.g., positioning method that was used to obtain the location information to the emergency centre or PSAP.

   7a. The INVITE is sent to an MGCF/MGW,

   7b. The IAM is continued towards the emergency centre or PSAP, or

   7c. The INVITE is sent directly to the emergency centre or PSAP.

8. The emergency call establishment is completed.

9. The PSAP may send a location request to the LRF to get the initial location information for the target UE, or to request LRF to get updated, i.e. current, location information for the target UE. The PSAP may determine the LRF based on the location and/or correlation information received in step 7. The PSAP may also include the correlation information in the request to the LRF. ***In the case of an IP capable PSAP, the location request may take the form of a location dereference request – e.g. a SIP SUBSCRIBE [IETF RFC 3856 [7]) or HELD request (IETF draft-winterbottom-geopriv-deref-protocol-00 [9]) – and may then include the location URI received in step 7.***

10. The LRF determines the target UE's location using one of the means listed in step 5 above. The LRF may use the correlation information received in step 9 to retrieve information about the UE that was stored in step 5.

11. The LRF returns the initial or updated location information to the emergency centre or PSAP. As an option for initial location, the LRF may instigate the location step 10 before the request in step 9 is received and may send the initial location to the emergency centre or PSAP either after the request in step 9 is received or before it is received. ***In the case of a location dereference request from an IP capable PSAP in step 9, the LRF may provide the appropriate location dereference response. In the case of location dereference using a SIP SUBSCRIBE request in step 9, this would take the form of a SIP NOTIFY (as defined in IETF draft-ietf-sip-location-conveyance-09 [5] and IETF RFC 3856 [7]) which would be sent whenever the LRF has new location information for the UE. In the case of a location dereference using a HELD request (IETF draft-winterbottom-geopriv-deref-protocol-00 [9]), this would take the form of a HELD response containing the location value obtained in step 10.***

12. The emergency call is released.

13. The IMS core may indicate to the LRF that the call is released. The LRF deletes any record stored in step 5.

6.4.4 Evaluation

The extensions to location retrieval that need to be supported by an LRF are consistent with what is already defined in TS 23.167 [2]. Mainly, the rather vague "correlation information" specified in TS 23.167 [2] is now replaced by specific types of location URI used by IETF and location retrieval by the PSAP uses specific IETF dereference capabilities. It is not yet clear whether IETF will allow several types of location URI and dereference protocols and, if so, which these will be. A possible way forward is proposed to include what is defined in existing RFCs and drafts. But it is possible that one specific type of location URI and dereference protocol might be agreed later for 3GPP use (in which case the changes to TS 23.167 [2] can be more specific than what is defined in this TR).

6.5 IMS Emergency Session Redirection enhancement

6.5.1 Discussion

TS 23.167 [2] specifies that a UE can be redirected to use PS for initiating an emergency registration and subsequent emergency session request. However, multimode UE can support multiple PS RATs and multiple PS RATs can be available at the location where the UE is at. Not all of the PS RATs may support IMS emergency services.

Rather than attempting emergency registrations on the available PS RATs, a UE could be directed to use or not use specific RAT types based on operator policy.

6.5.2 Architectural Details

No architectural changes to TS 23.167 [2] are needed.

6.5.3 Information Flows

Detailed information flows could be added to TS 23.167 [2] showing enhanced IMS emergency redirection.

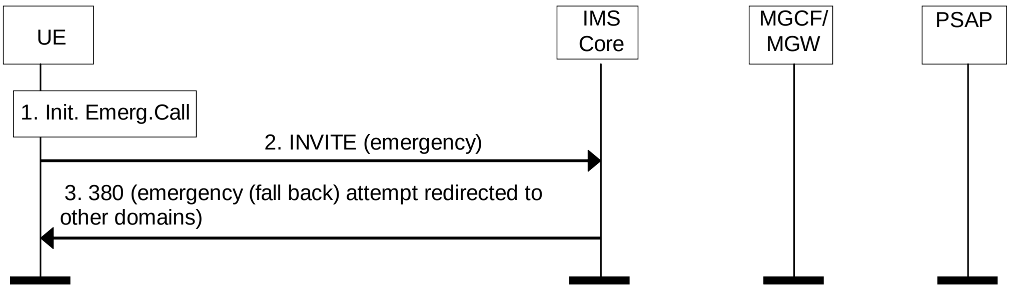

Figure 6.5.3-1: Handling of enhanced IMS emergency redirection indicator

1. The user initiates an emergency call. Optionally the UE could perform a wide band search and provide indicators for wide bands RATs available at the location the UE is at.
2. The UE sends a SIP INVITE request with an emergency identifier, and if the UE as a result of selecting the RAT to make an emergency call had performed a wideband scan, the UE includes indicators for wide bands RATs available at the location the UE is at, to the IMS core.
3. The IMS core determines IMS emergency services are not supported and returns a 380 (Alternative Service) response with:
   - the type set to "emergency";
   - optionally, an indication, IMS emergency registration required as a result of emergency session establishment attempt; and
   - optionally, an indication, a domain switch to another PS RAT required as a result of lack of support for IMS emergency services in the presently tried domain. The indication may be: use these RAT type or don't use these RAT types.

6.5.4 Evaluation

Providing guidance to the UE regarding the RAT to choose will decrease the emergency session set up time as experienced by the user.

7 Conclusions

Relatively simple backward compatible extensions to the solution for IMS emergency calls are described here in clauses 6.1 and 6.2 that enable the solution to better support IMS emergency calls from a greater variety of access networks. In both clauses, it assumed that an IMS emergency call attempt from the UE is initially served by a 3GPP conforming VSP that either does not fully support emergency calls or does not support emergency calls for the UE's location. The procedure in clause 6.1 allows the VSP to redirect the call to a better (e.g. local) VSP whereas the procedure in clause 6.2 allows the VSP to forward the call to such a VSP. These procedures address the following objective from clause 1:

- Evaluate the feasibility of supporting IMS emergency calls for combinations of IP access network A and IMS core network B not supported in Rel-7 including but not limited to the following cases:
    - A is any IP access network and B is the home 3GPP compliant IMS network for any emergency calling UE with adequate security credentials
    - A is any IP access network and B is a visited 3GPP compliant IMS network for any emergency calling roaming UE with adequate security credentials

It should be noted that while the solution in clause 6.2 seems technically feasible at a stage 2 level, it has been pointed out that the appropriate interface between the forwarding and forwarded to networks is not clear and that use of this solution may be an issue for regulatory bodies with jurisdiction over the forwarding network and/or forwarded to network. Therefore this solution is not appropriate and needs further study.

In clause 6.3, flexibility is more explicitly included to allow a greater diversity of location solutions for any IMS emergency call. Except for OMA SUPL, particular solutions are not identified but this would not restrict an operator's deployment options. This clause addresses part of the following objective in clause 1:

- Evaluate other enhancements to the solution for IMS emergency calls in Release 7 that may improve performance and/or reduce complexity

In clause 6.4, increased alignment is provided with draft IETF location by reference solutions which would enable a common PSAP interface for location to both 3GPP and IETF conforming networks. This addresses the following objective from clause 1:

- Evaluate the feasibility of better aligning the solution in TS 23.167 with applicable IETF standards and draft standards (e.g., from the Ecrit and Geopriv working groups)

In clause 6.5, another type of emergency call redirection is described, different to that in clause 6.1, in which an initially attempted VSP redirects an emergency call to or away from specific types of RAT.

Having addressed most of the objectives in clause 1, it is seen that the TR is mostly complete and could serve as the basis of a future WI to include some or all of the enhancements in the specifications.

Annex A: Change history

Change history								
Date	**TSG #**	**TSG Doc.**	**CR**	**Rev**	**Cat**	**Subject/Comment**	**Old**	**New**
2007-10	SA2#60	-	-	-	-	Initial skeleton		0.0.1
2007-11	SA2#61	-	-	-	-	Includes P-CR in S2-075486	0.0.1	0.1.0
2008-01	SA2#62	-	-	-	-	Includes P-CRs in S2-080610, S2-080898	0.1.0	0.2.0
2008-04	SA2#64	-	-	-	-	Includes P-CR in S2-083073	0.2.0	0.3.0
2008-08	SA2#67	-	-	-	-	Includes P-CR in S2-085940	0.3.0	0.4.0
2008-09	SP-41	SP-080552	-	-	-	MCC Update for presentation to TSG SA#41 for information	0.4.0	1.0.0
2008-10	SA2#68	-	-	-	-	Includes P-CR in S2-087213	1.0.0	1.1.0
2008-11	SA2#69	-	-	-	-	Includes P-CRs in S2-087921 and S2-088239	1.1.0	1.2.0
2008-11	SP-42	SP-080836	-	-	-	MCC Editorial update for presentation to TSG SA for Approval	1.2.0	2.0.0
2008-12	SP-42	-	-	-	-	MCC Editorial update for publication as Release 9	2.0.0	9.0.0