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Best Current Practice for Communications Services in
Support of Emergency Calling

Abstract

The IETF and other standards organizations have efforts targeted at standardizing various aspects of placing emergency calls on IP networks. This memo describes best current practice on how devices, networks, and services using IETF protocols should use such standards to make emergency calls.

Status of This Memo

This memo documents an Internet Best Current Practice.

This document is a product of the Internet Engineering Task Force (IETF). It represents the consensus of the IETF community. It has received public review and has been approved for publication by the Internet Engineering Steering Group (IESG). Further information on BCPS is available in Section 2 of RFC 5741.

Information about the current status of this document, any errata, and how to provide feedback on it may be obtained at <http://www.rfc-editor.org/info/rfc6881>.

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1. Introduction

This document describes how access networks, Session Initiation Protocol [RFC3261] user agents, proxy servers, and Public Safety Answering Points (PSAPs) support emergency calling, as outlined in [RFC6443], which is designed to complement the present document in section headings, numbering, and content. Understanding [RFC6443] is necessary to understand this document. This Best Current Practice (BCP) succinctly describes the requirements of end devices and applications (requirements prefaced by "ED-"), access networks (including enterprise access networks) (requirements prefaced by "AN-"), service providers (requirements prefaced by "SP-"), and PSAPs to achieve globally interoperable emergency calling on the Internet.

This document also defines requirements for "intermediate" devices that exist between end devices or applications and the access network. For example, a home router is an intermediate device. Reporting location on an emergency call (see Section 6) may depend on the ability of such intermediate devices to meet the requirements prefaced by "INT-".

The access network requirements apply to those networks that may be used to place emergency calls using IETF protocols. Local regulations may impact the need to support this document's access network requirements.

Other organizations, such as the National Emergency Number Association (NENA), define the PSAP interface. NENA's documents reference this document.

2. Terminology

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [RFC2119].

This document uses terms from [RFC3261], [RFC5012], and [RFC6443].

3. Overview of How Emergency Calls Are Placed

An emergency call can be distinguished (Section 5) from any other call by a unique service URN [RFC5031] that is placed in the call setup signaling when a home or visited emergency dial string is detected. Because emergency services are local to specific geographic regions, a caller must obtain his location (Section 6) prior to making emergency calls. To get this location, either a form of measuring (e.g., GPS) ([RFC6443] Section 6.2.3) device location in

the endpoint is deployed or the endpoint is configured (Section 6.5) with its location from the access network's Location Information Server (LIS). The location is conveyed (Section 6.7) in the SIP signaling with the call. The call is routed (Section 8) based on location using the Location-to-Service Translation (LoST) protocol [RFC5222], which maps a location to a set of PSAP URIs. Each URI resolves to a PSAP or an Emergency Services Routing Proxy (ESRP) that serves a group of PSAPs. The call arrives at the PSAP with the location included in the SIP INVITE request.

4. Which Devices and Services Should Support Emergency Calls?

ED-1: A device or application that implements SIP calling SHOULD support emergency calling. Some jurisdictions have regulations governing which devices need to support emergency calling, and developers are encouraged to ensure that devices they develop meet relevant regulatory requirements. Unfortunately, the natural variation in those regulations also makes it impossible to accurately describe the cases when developers do or do not have to support emergency calling.

SP-1: If a device or application expects to be able to place a call for help, the service provider that supports it MUST facilitate emergency calling. Some jurisdictions have regulations governing this.

ED-2: Devices that create media sessions and exchange real-time audio, video, and/or text and that have the capability to establish sessions to a wide variety of addresses and communicate over private IP networks or the Internet SHOULD support emergency calls. Some jurisdictions have regulations governing this.

5. Identifying an Emergency Call

ED-3: Endpoints SHOULD recognize dial strings of emergency calls. If the service provider always knows the location of the device (the correct dial string depends on which country a caller is in), the service provider may recognize them; see SP-2.

SP-2: Proxy servers SHOULD recognize emergency dial strings if for some reason the endpoint does not recognize them.

ED-4/SP-3: Emergency calls MUST be marked with a service URN in the Request-URI of the INVITE.

ED-5/SP-4: Geographically local dial strings MUST be recognized.

- ED-6/SP-5: Devices MUST be able to be configured with the home country from which the home dial string(s) can be determined.
- ED-7/SP-6: Emergency dial strings SHOULD be determined from LoST [RFC5222]. Dial strings MAY be configured directly into the device.
- AN-1: LoST servers MUST return dial strings for emergency services.
- ED-8: Endpoints that do not recognize emergency dial strings SHOULD send dial strings as per [RFC4967].
- SP-7: If a proxy server recognizes dial strings on behalf of its clients, it MUST recognize emergency dial strings represented by [RFC4967] and SHOULD recognize the emergency dial strings represented by a tel URI [RFC3966].
- ED-9: Endpoints SHOULD be able to have home dial strings provisioned.
- SP-8: Service providers MAY provision home dial strings in devices.
- ED-10: Devices SHOULD NOT have one-button emergency calling initiation.
- ED-11/SP-9: All sub-services for the 'sos' service specified in [RFC5031] MUST be recognized.

6. Location and Its Role in an Emergency Call

Handling location for emergency calling usually involves several steps to process, and multiple entities are involved. In Internet emergency calling, where the endpoint is located is determined using a variety of measurement or wire-tracing methods. Endpoints can be configured with their own location by the access network. In some circumstances, a proxy server can insert location into the signaling on behalf of the endpoint. The location is mapped to the URI to send the call to, and the location is conveyed to the PSAP (and other entities) in the signaling. Likewise, we employ Location Configuration Protocols (LCPs), the Location-to-Service Mapping Protocol, and Location Conveyance Protocols for these functions. The Location-to-Service Translation protocol [RFC5222] is the Location Mapping Protocol defined by the IETF.

6.1. Types of Location Information

There are several forms of location. All IETF location configuration and location conveyance protocols support both civic and geospatial (geo) forms. The civic forms include both postal and jurisdictional fields. A cell tower/sector can be represented as a point (geo or civic) or polygon. Endpoints, intermediate devices, and service providers receiving other forms of location representation MUST map them into either a geo or civic for use in emergency calls.

ED-12/INT-1/SP-10: Endpoints, intermediate devices, and service providers MUST be prepared to handle location represented in either civic or geo form.

ED-13/INT-2/SP-11/AN-2: Entities MUST NOT convert (civic to geo or geo to civic) from the form of location that the determination mechanism (see Section 6.2) supplied prior to receipt by the PSAP.

6.2. Location Determination

ED-14/INT-3/AN-3: Any location determination mechanism MAY be used, provided the accuracy of the location meets local requirements.

6.2.1. User-Entered Location Information

ED-15/INT-4/AN-4: Devices, intermediate devices, and/or access networks SHOULD support a manual method to override the location the access network determines. When the override location is supplied in civic form, it MUST be possible for the resultant Presence Information Data Format Location Object (PIDF-LO) received at the PSAP to contain any of the elements specified in [RFC4119] and [RFC5139].

6.2.2. Access Network "Wire Database" Location Information

AN-5: Access networks supporting copper, fiber, or other hard-wired IP packet services SHOULD support location configuration. If the network does not support location configuration, it MUST require every device or intermediate device that connects to the network to support end system measured location.

AN-6/INT-5: Access networks and intermediate devices providing wire database location information SHOULD provide interior location data (building, floor, room, cubicle) where possible. It is RECOMMENDED that interior location be provided when spaces exceed approximately 650 square meters. See [RFC6443] Section 6.2.2 for a discussion of how this value was determined.

AN-7/INT-6: Access networks and intermediate devices (including enterprise networks) that support intermediate range wireless connections (typically 100 m or less of range) and that do not support a more accurate location determination mechanism such as triangulation MUST support location configuration where the location of the access point is reflected as the location of the clients of that access point.

AN-8/INT-7: Where the access network provides location configuration, intermediate devices MUST either be transparent to it or provide an interconnected client for the supported configuration mechanism and a server for a configuration protocol supported by end devices downstream of the intermediate device such that the location provided by the access network is available to clients as if the intermediate device was not in the path.

6.2.3. End System Measured Location Information

ED-16/INT-8: Devices MAY support end system measured location. See [RFC6443] Section 6 for a discussion of accuracy of location.

ED-17/INT-9/AN-9: Devices that support endpoint measuring of location MUST have at least a coarse location capability (typically <1 km accuracy) for the routing of calls. The location mechanism MAY be a service provided by the access network.

6.2.4. Network Measured Location Information

AN-10: Access networks MAY provide network measured location determination. Wireless access networks that do not supply network measured location MUST require every device or intermediate device connected to the network to support end system measured location. Uncertainty and confidence may be specified by local regulation. Where not specified, uncertainty of less than 100 meters with 95% confidence is RECOMMENDED for dispatch location.

AN-11: Access networks that provide network measured location MUST have at least a coarse location (typically <1 km when not location hiding) capability at all times for the routing of calls.

AN-12: Access networks with a range of <10 meters (e.g., personal area networks such as Bluetooth) MUST provide a location to mobile devices connected to them. The location provided SHOULD be that reported by the upstream access network unless a more accurate mechanism is available.

6.3. Who Adds Location? The Endpoint, or the Proxy?

ED-18/INT-10: Endpoints SHOULD attempt to configure their own location using the Location Configuration Protocols (LCPs) listed in ED-21.

SP-12: Proxies MAY provide location on behalf of devices if:

- o The proxy has a relationship with all access networks the device could connect to, and the relationship allows it to obtain location.
- o The proxy has an identifier, such as an IP address, that can be used by the access network to determine the location of the endpoint, even in the presence of NAT and VPN tunnels that may obscure the identifier between the access network and the service provider.

ED-19/INT-11/SP-13: Where proxies provide location on behalf of endpoints, the service provider MUST ensure that either the end device is provided with the local dial strings for its current location (where the end device recognizes dial strings) or the service provider proxy MUST detect the appropriate local dial strings at the time of the call.

6.4. Location and References to Location

ED-20/INT-12: Devices SHOULD be able to accept and forward location-by-value or location-by-reference. An end device that receives location-by-reference (and does not also get the corresponding value) MUST be able to perform a dereference operation to obtain a value.

6.5. End System Location Configuration

Obtaining location from the access network may be preferable even if the device can measure its own location, especially indoors where most measurement mechanisms are not accurate enough. The requirements listed in this section do not apply to devices that can accurately measure their own location.

- ED-21/INT-13: Devices MUST support both the Dynamic Host Configuration Protocol (DHCP) location options [RFC4776] [RFC6225] and HTTP-Enabled Location Delivery (HELD) [RFC5985]. When devices deploy a specific access network interface for which location configuration mechanisms such as Link Layer Discovery Protocol - Media Endpoint Discovery (LLDP-MED) [LLDP-MED] or 802.11v are specified, the device SHOULD support the additional respective access network specific location configuration mechanism.
- AN-13/INT-14: The access network MUST support either DHCP location options or HELD. The access network SHOULD support other location configuration technologies that are specific to the type of access network.
- AN-14/INT-15: Where a router is employed between a LAN and WAN in a small (less than approximately 650 square meters) area, the router MUST be transparent to the location provided by the WAN to the LAN. This may mean the router must obtain location as a client from the WAN and supply an LCP server to the LAN with the location it obtains. Where the area is larger, the LAN MUST have a location configuration mechanism satisfying the requirements of this document.
- ED-22/INT-16: Endpoints SHOULD try all LCPs supported by the device in any order or in parallel. The first one that succeeds in supplying location MUST be used.
- AN-15/INT-17: Access networks that support more than one LCP MUST reply with the same location information (within the limits of the data format for the specific LCP) for all LCPs it supports.
- ED-23/INT-18/SP-14: When HELD is the LCP, the request MUST specify a value of "emergencyRouting" for the "responseTime" parameter and use the resulting location for routing. If a value for dispatch location will be sent, another request with the "responseTime" parameter set to "emergencyDispatch" must be completed, with the result sent for dispatch purposes.
- ED-24: Where the operating system supporting application programs that need location for emergency calls does not allow access to Layer 2 and Layer 3 functions necessary for a client application to use DHCP location options and/or other location technologies that are specific to the type of access network, the operating system MUST provide a published API conforming to ED-12 through ED-23 and ED-25 through ED-32. It is RECOMMENDED that all operating systems provide such an API.

6.6. When Location Should Be Configured

If an endpoint is manually configured, the requirements in this section are not applicable.

- ED-25/INT-19: Endpoints SHOULD obtain location immediately after obtaining local network configuration information.
- ED-26/INT-20: If the device is configured to use DHCP for bootstrapping and does not use its own measurement to determine location, it MUST include both options for location acquisition (civic and geodetic), the option for LIS discovery, and the option for LoST discovery as defined in [RFC4776], [RFC6225], [RFC5986], and [RFC5223], respectively.
- ED-27/INT-21: If the device sends a DHCPINFORM message, it MUST include both options for location acquisition (civic and geodetic), the option for LIS discovery, and the option for LoST discovery as defined in [RFC4776], [RFC6225], [RFC5986], and [RFC5223], respectively.
- ED-28/INT-22: To minimize the effects of VPNs that do not allow packets to be sent via the native hardware interface rather than via the VPN tunnel, location configuration SHOULD be attempted before such tunnels are established.
- ED-29/INT-23: Software that uses LCPs SHOULD locate and use the actual hardware network interface rather than a VPN tunnel interface to direct LCP requests to the LIS in the actual access network.
- AN-16: Network administrators MUST take care in assigning IP addresses such that VPN address assignments can be distinguished from local devices (by subnet choice, for example), and LISs SHOULD NOT attempt to provide location to addresses that arrive via VPN connections unless they can accurately determine the location for such addresses.
- AN-17: Placement of NAT devices where an LCP uses an IP address for an identifier SHOULD consider the effect of the NAT on the LCP. The address used to query the LIS MUST be able to correctly identify the record in the LIS representing the location of the querying device.
- ED-30/INT-24: For devices that are not expected to change location, refreshing location on the order of once per day is RECOMMENDED.

ED-31/INT-25: For devices that roam, refresh of location information SHOULD be more frequent, with the frequency related to the mobility of the device and the ability of the access network to support the refresh operation. If the device detects a link state change that might indicate having moved, for example, when it changes access points, the device SHOULD refresh its location.

ED-32/INT-26/AN-18: It is RECOMMENDED that location determination not take longer than 250 ms to obtain routing location, and systems SHOULD be designed such that the typical response time is under 100 ms. However, as much as 3 seconds to obtain routing location MAY be tolerated if location accuracy can be substantially improved over what can be obtained in 250 ms.

6.7. Conveying Location

ED-33/SP-15: Location sent between SIP entities MUST be conveyed using the extension described in [RFC6442].

6.8. Location Updates

ED-34/AN-19: Where the absolute location or the accuracy of location of the endpoint may change between the time the call is received at the PSAP and the time dispatch is completed, location update mechanisms MUST be implemented and used.

ED-35/AN-20: Mobile devices MUST be provided with a mechanism to get repeated location updates to track the motion of the device during the complete processing of the call.

ED-36/AN-21: The LIS SHOULD provide a location reference that permits a subscription with appropriate filtering.

ED-37/AN-22: For calls sent with location-by-reference, with a SIP or Session Initiation Protocol Secure (SIPS) scheme, the server resolving the reference MUST support a SUBSCRIBE [RFC6665] to the presence event [RFC3856]. For other location-by-reference schemes that do not support subscription, the PSAP will have to repeatedly dereference the URI to determine if the device moved.

ED-38: If location was sent by value and the endpoint gets an updated location, it MUST send the updated location to the PSAP via a SIP re-INVITE or UPDATE request. Such updates SHOULD be limited to no more than one update every 10 seconds, a value selected to keep the load on a large PSAP manageable, and yet provide sufficient indication to the PSAP of motion.

6.9. Multiple Locations

- ED-39/SP-16: If the LIS has more than one location for an endpoint, it MUST conform to the rules in Section 3 of [RFC5491].
- ED-40: If an endpoint has more than one location available to it, it MUST choose one location to route the call towards the PSAP. If multiple locations are in a single Presence Information Data Format (PIDF), the procedures in [RFC5491] MUST be followed. If the endpoint has multiple PIDFs and has no reasonable basis to choose from among them, a random choice is acceptable.
- SP-17: If a proxy inserts location on behalf of an endpoint and it has multiple locations available for the endpoint, it MUST choose one location to use to route the call towards the PSAP. If multiple locations are in a single PIDF, the procedures in [RFC5491] MUST be followed. If the proxy has multiple PIDFs and has no reasonable basis to choose from among them, a random choice is acceptable.
- SP-18: If a proxy is attempting to insert location but the endpoint conveyed a location to it, the proxy MUST use the endpoint's location for routing in the initial INVITE and MUST convey that location towards the PSAP. It MAY also include what it believes the location to be in a separate Geolocation header.
- SP-19: All location objects received by a proxy MUST be delivered to the PSAP.
- ED-41/SP-20: Location objects MUST be created with information about the method by which the location was determined, such as GPS, manually entered, or based on access network topology included in a PIDF-LO "method" element. In addition, the source of the location information MUST be included in a PIDF-LO "provided-by" element.
- ED-42/SP-21: A location with a method of "derived" MUST NOT be used unless no other location is available.

6.10. Location Validation

- AN-23: A LIS SHOULD perform location validation of civic locations via LoST before entering a location in its database.
- ED-43: Endpoints SHOULD validate civic locations when they receive them from their LCP. Validation SHOULD be performed in conjunction with the LoST route query to minimize load on the LoST server.

6.11. Default Location

AN-24: When the access network cannot determine the actual location of the caller, it **MUST** supply a default location. The default **SHOULD** be chosen to be as close to the probable location of the device as the network can determine. See [RFC6443].

SP-22: Proxies handling emergency calls **MUST** insert a default location in the INVITE if the incoming INVITE does not contain a location and the proxy does not have a method for obtaining a better location.

AN-25/SP-23: Default locations **MUST** be marked with method=Default, and the proxy **MUST** be identified in a PIDF-LO "provided-by" element.

6.12. Other Location Considerations

ED-44: If the LCP does not return location in the form of a PIDF-LO [RFC4119], the endpoint **MUST** map the location information it receives from the configuration protocol to a PIDF-LO.

ED-45/AN-26: To prevent against spoofing of the DHCP server, entities implementing DHCP for location configuration **SHOULD** use DHCPv4 message authentication [RFC3118] or DHCPv6 message authentication [RFC3315], although the difficulty in providing appropriate credentials is significant.

ED-46: If S/MIME [RFC5751] is used, the INVITE message **MUST** provide enough information unencrypted for intermediate proxies to route the call based on the location information included. This would include the Geolocation header and any bodies containing location information. Use of S/MIME with emergency calls is **NOT RECOMMENDED** for this reason.

ED-47/SP-24: Transport Layer Security (TLS) [RFC5746] **MUST** be used to protect location (but see Section 9.1). All SIP implementations of this specification **MUST** support TLS.

7. LIS and LoST Discovery

ED-48: Endpoints **MUST** support one or more mechanisms that allow them to determine their public IP address, for example, Session Traversal Utilities for NAT (STUN) [RFC5389].

ED-49: Endpoints **MUST** support LIS discovery as described in [RFC5986] and LoST discovery as described in [RFC5223].

ED-50: The device MUST have a configurable default LoST server parameter.

ED-51: DHCP LoST discovery MUST be used, if available, in preference to configured LoST servers. That is, the endpoint MUST send queries to this LoST server first, using other LoST servers only if these queries fail.

AN-27: Access networks that support DHCP MUST implement the LIS and LoST discovery options in their DHCP servers and return suitable server addresses as appropriate.

8. Routing the Call to the PSAP

ED-52: Endpoints that obtain their own location SHOULD perform LoST mapping to the PSAP URI.

ED-53: Mapping SHOULD be performed at boot time and whenever a location changes beyond the service boundary obtained from a prior LoST mapping operation, or when the time-to-live value of that response has expired. The value MUST be cached for possible later use.

ED-54: The endpoint MUST attempt to update its location at the time of an emergency call. If it cannot obtain a new location quickly (see Section 6), it MUST use the cached value.

ED-55: The endpoint SHOULD attempt to update the LoST mapping at the time of an emergency call. If it cannot obtain a new mapping quickly, it MUST use the cached value. If the device cannot update the LoST mapping and does not have a cached value, it MUST signal an emergency call without a Route header containing a PSAP URI.

SP-25: Networks MUST be designed so that at least one proxy in the outbound path will recognize emergency calls with a Request URI of the service URN in the "sos" tree. An endpoint places a service URN in the Request URI to indicate that the endpoint understood the call was an emergency call. A proxy that processes such a call looks for the presence of a SIP Route header field with a URI of a PSAP. The absence of such a Route header indicates that the endpoint was unable to invoke LoST, and the proxy MUST perform the LoST mapping and insert a Route header field with the URI obtained.

- SP-26: To deal with old user agents that predate this specification and with endpoints that do not have access to their own location data, a proxy that recognizes a call as an emergency call that is not marked as such (see Section 5) MUST also perform this mapping, with the best location it has available for the endpoint. The resulting PSAP URI would be placed in a Route header with the service URN in the Request URI.
- SP-27: Proxy servers performing mapping SHOULD use location obtained from the access network for the mapping. If no location is available, a default location (see Section 6.11) MUST be supplied.
- SP-28: A proxy server that attempts mapping and fails to get a mapping MUST provide a default mapping. A suitable default mapping would be the mapping obtained previously for the default location appropriate for the caller.
- ED-56/SP-29: [RFC3261] and [RFC3263] procedures MUST be used to route an emergency call towards the PSAP's URI.

9. Signaling of Emergency Calls

9.1. Use of TLS

- ED-57/SP-30: TLS is the primary mechanism used to secure the signaling for emergency calls. IPsec [RFC4301] MAY be used instead of TLS for any hop. Either TLS or IPsec MUST be used when attempting to signal an emergency call.
- ED-58/SP-31: If TLS session establishment is not available or fails, the call MUST be retried without TLS.
- ED-59/SP-32: Following the procedures described in [RFC5626] is RECOMMENDED to maintain persistent TLS connections between entities when one of the entities is an endpoint. Persistent TLS connection between proxies is RECOMMENDED using any suitable mechanism.
- ED-60/AN-28: TLS SHOULD be used when attempting to retrieve location (configuration or dereferencing) with HELD. The use of the mechanism described in [RFC5077] is RECOMMENDED to minimize the time to establish TLS sessions without keeping server-side state. IPsec MAY be used instead of TLS.
- ED-61/AN-29: When TLS session establishment fails, the location retrieval MUST be retried without TLS.

9.2. SIP Signaling Requirements for User Agents

ED-62: The initial SIP signaling method is an INVITE request:

1. The Request URI SHOULD be the service URN in the "sos" tree. If the device does not interpret local dial strings, the Request-URI MUST be a dial string URI [RFC4967] with the dialed digits.
2. The To header field SHOULD be a service URN in the "sos" tree. If the device does not interpret local dial strings, the To: MUST be a dial string URI with the dialed digits.
3. The From header field SHOULD contain the address of record (AoR) of the caller.
4. A Route header field SHOULD be present with a PSAP URI obtained from LoST (see Section 8). If the device does not interpret dial plans or was unable to obtain a route from a LoST server, no such Route header field will be present.
5. A Contact header field MUST be globally routable, for example, a Globally Routable User Agent URI (GRUU) [RFC5627], and be valid for several minutes following the termination of the call, provided that the User Agent Client (UAC) remains registered with the same registrar, to permit an immediate callback to the specific device that placed the emergency call. It is acceptable if the UAC inserts a locally routable URI and a subsequent back-to-back user agent (B2BUA) maps that to a globally routable URI.
6. Other header fields MAY be included as per normal SIP behavior.
7. If a geolocation URI is included in the INVITE, a Supported header field MUST be included with a 'geolocation-sip' or 'geolocation-http' option tag, as appropriate [RFC6442].
8. If a device understands the SIP location conveyance [RFC6442] extension and has its location available, it MUST include location as either location-by-value or location-by-reference, or both, according to the rules within RFC 6442.
9. An SDP offer SHOULD be included in the INVITE. If voice is supported, the offer SHOULD include the G.711 codec; see Section 14. As PSAPs may support a wide range of media types and codecs, sending an offerless INVITE may result in a lengthy return offer but is permitted. Cautions in [RFC3261] on offerless INVITEs should be considered before such use.

10. If the device includes location-by-value, the user agent (UA) MUST support multipart message bodies, since SDP will likely be also in the INVITE.

9.3. SIP Signaling Requirements for Proxy Servers

SP-33: SIP proxy servers processing emergency calls:

1. If the proxy interprets dial plans on behalf of user agents, the proxy MUST look for the local emergency dial string at the location of the end device and MAY look for the home dial string. If it finds it, the proxy MUST:
 - * Insert a Geolocation header field. Location-by-reference MUST be used because proxies are not allowed to insert bodies.
 - * Insert the Geolocation-Routing header with appropriate parameters.
 - * Map the location to a PSAP URI using LoST.
 - * Add a Route header with the PSAP URI.
 - * Replace the Request-URI, which was the dial string, with the service URN appropriate for the emergency dial string.
 - * Route the call using normal SIP routing mechanisms.
2. If the proxy recognizes the service URN in the Request URI and does not find a Route header, it MUST query a LoST server immediately. If a location was provided (which should be the case), the proxy uses that location to query LoST. The proxy may have to dereference a location-by-reference to get a value. If a location is not present and the proxy can query a LIS that has the location of the UA, it MUST do so. If no location is present and the proxy does not have access to a LIS that could provide location, the proxy MUST supply a default location (see Section 6.11). The location (in the signaling, obtained from a LIS, or default) MUST be used in a query to LoST with the service URN received with the call. The resulting URI MUST be placed in a Route header added to the call.
3. The proxy MAY add a Geolocation header field. Such an additional location SHOULD NOT be used for routing; the location provided by the UA should be used.

4. Either a P-Asserted-Identity [RFC3325] or an Identity header field [RFC4474], or both, SHOULD be included to identify the sender. For services that must support emergency calls from unauthenticated devices, valid identity may not be available. Proxies encountering a P-Asserted-Identity will need to pass the header to the PSAP, which is in a different domain. [RFC3325] requires a "spec(T)" to determine what happens if either the "id" privacy service or a Privacy header is present and requests privacy. In the absence of another spec(T), such proxies should pass the header unmodified if and only if the connection between the proxy and the PSAP is, as far as the proxy can determine, protected by TLS with mutual authentication using keys reliably known by the parties, encrypted with no less strength than AES, and the local regulations governing the PSAP do not specify otherwise.
 5. Proxies SHOULD NOT return a 424 error. They should process the INVITE as best they can.
 6. Proxies SHOULD NOT obey a Geolocation-Routing value of "no" or a missing value if they must query LoST to obtain a route. Emergency calls are always routed by location.
10. Callbacks
- ED-63/SP-34: Devices SHOULD have a globally routable URI in a Contact header field that remains valid for several minutes past the time the original call containing the URI completes, unless the device registration expires and is not renewed.
- SP-35: Callbacks to the Contact header URI received within 30 minutes of an emergency call must reach the device regardless of call features (e.g., do not disturb) or services (e.g., call forwarding) that would normally cause the call to be routed to some other entity.
- SP-36: Devices MUST have a persistent AoR URI either in a P-Asserted-Identity header field or From protected by an Identity header field suitable for returning a call sometime after the original call. Such a callback would not necessarily reach the device that originally placed the call.

11. Mid-Call Behavior

ED-64/SP-37: During the course of an emergency call, PSAPs and responders may need to transfer the call to some other entity. The request for such a transfer is signaled by a REFER request within the dialog with method=INVITE and a Refer-To header field [RFC3515]. Devices MUST react to such a transfer request with the appropriate INVITE.

12. Call Termination

ED-65: Normal [RFC3261] procedures for termination MUST be used for termination of the call.

13. Disabling of Features

ED-66/SP-38: User agents and proxies MUST disable features that will interrupt an ongoing emergency call, such as:

- o Call waiting
- o Call transfer
- o Three-way call
- o Hold
- o Outbound call blocking

when an emergency call is established, but see ED-65 with respect to call waiting. Also see ED-73 in Section 14.

ED-67/SP-39: The emergency dial strings SHOULD NOT be permitted in call forward numbers or speed dial lists.

ED-68/SP-40: The user agent and proxies MUST disable call features that would interfere with the ability of callbacks from the PSAP to be completed, such as:

- o Do not disturb
- o Call forward (all kinds)

These features SHOULD be disabled for approximately 30 minutes following termination of an emergency call.

ED-69: Callbacks SHOULD be determined by retaining the domain of the PSAP that answers an outgoing emergency call and instantiating a timer that starts when the call is terminated. If a call is received from the same domain and within the timer period, and it is sent to the URI in a Contact header or the AoR used in the emergency call, then it should be assumed to be a callback. The suggested timer period is 5 minutes. The mechanism described in [RFC4916] can be used by the PSAP to inform the endpoint of the PSAP's domain. Recognizing a callback from the domain of the PSAP will not always work, and further standardization will be required to give the endpoint the ability to recognize a callback.

14. Media

ED-70: Endpoints MUST send and receive media streams on RTP [RFC3550].

ED-71: Normal SIP offer/answer [RFC3264] negotiations MUST be used to agree on the media streams to be used.

ED-72/SP-41: G.711 A-law (and mu-law if they are intended to be used in North America) encoded voice as described in [RFC3551] MUST be supported. If the endpoint cannot support G.711, a transcoder MUST be used so that the offer received at the PSAP contains G.711. It is desirable to include wideband codecs such as G.722 and Adaptive Multi-Rate - WideBand (AMR-WB) in the offer. PSAPs SHOULD support narrowband codecs common on endpoints in their area to avoid transcoding.

ED-73: Silence suppression (Voice Activity Detection methods) MUST NOT be used on emergency calls. PSAP call takers sometimes get information on what is happening in the background to determine how to process the call.

ED-74: Endpoints supporting Instant Messaging (IM) MUST support either [RFC3428] or [RFC4975].

ED-75: Endpoints supporting real-time text MUST comply with [RFC4103]. The expectations for emergency service support for the real-time text medium are described in [RFC5194] Section 7.1.

ED-76: Endpoints supporting video MUST support H.264 per [RFC6184].

15. Testing

- ED-77: INVITE requests to a service URN starting with "test." indicate a request for an automated test, for example, "urn:service:test.sos.fire". As in standard SIP, a 200 (OK) response indicates that the address was recognized and a 404 (not found) that it was not. A 486 (busy here) MUST be returned if the test service is busy, and a 404 (not found) MUST be returned if the PSAP does not support the test mechanism.
- ED-78: In its response to the test, the PSAP MAY include a text body (text/plain) indicating the identity of the PSAP, the requested service, and the location reported with the call. For the latter, the PSAP SHOULD return location-by-value even if the original location delivered with the test was location-by-reference. If the location-by-reference was supplied and the dereference requires credentials, the PSAP SHOULD use credentials supplied by the LIS for test purposes. This alerts the LIS that the dereference is not for an actual emergency call, and therefore location-hiding techniques, if they are being used, may be employed for this dereference. Use of SIPS for the request would assure that the response containing the location is kept private.
- ED-79: A PSAP accepting a test call SHOULD accept a media loopback [RFC6849] test and SHOULD support the "rtp-pkt-loopback" and "rtp-media-loopback" options. The user agent would specify a loopback attribute of "loopback-source", the PSAP being the mirror. User agents should expect the PSAP to loop back no more than 3 packets of each media type accepted (which limits the duration of the test), after which the PSAP would normally send BYE.
- ED-80: User agents SHOULD perform a full call test, including media loopback, after a disconnect and subsequent change in IP address not due to a reboot. After an initial test, a full test SHOULD be repeated approximately every 30 days with a random interval.
- ED-81: User agents MUST NOT place a test call immediately after booting. If the IP address changes after booting, the endpoint should wait a random amount of time (in perhaps a 30-minute period, sufficient for any avalanche-restart event to complete) and then test.
- ED-82: PSAPs MAY refuse repeated requests for test from the same device in a short period of time. Any refusal is signaled with a 486 (busy here) or 488 (not acceptable here) response.

16. Security Considerations

Security considerations for emergency calling have been documented in [RFC5069] and [RFC6280]. This document suggests that security (TLS or IPsec) be used hop by hop on a SIP call to protect location information, identity, etc. It also suggests that if the attempt to create a security association fails the call be retried without the security. It's more important to get an emergency call through than to protect the data; indeed, in many jurisdictions privacy is explicitly waived when making emergency calls. Placing a call without security may reveal user information, including location. The alternative -- failing the call if security cannot be established -- is considered unacceptable.

17. IANA Considerations

This document registers service URNs in the Service URN Labels registry per [RFC5031] for testing.

17.1. Test Service URN

A new entry in the URN Service Label registry has been added. The new service is "test", the reference is this document, and the description is "self-test".

17.2. 'test' Subregistry

A new subregistry has been created: 'test' Sub-Services. The registration process is Expert Review per [RFC5226]. The expert review should consider that the entries in this registry nominally track the entries in the 'sos' subregistry, although it is not required that every entry in 'sos' have an entry in 'test', and it is possible that entries in the 'test' subregistry may not necessarily be in the 'sos' subregistry. For example, testing of non-emergency URNs may be allowed. The reference is this document. The initial content of the subregistry is:

Service	Reference	Description
test.sos	RFC 6881	test for sos
test.sos.ambulance	RFC 6881	test for sos.ambulance
test.sos.animal-control	RFC 6881	test for sos.animal-control
test.sos.fire	RFC 6881	test for sos.fire
test.sos.gas	RFC 6881	test for sos.gas
test.sos.marine	RFC 6881	test for sos.marine
test.sos.mountain	RFC 6881	test for sos.mountain
test.sos.physician	RFC 6881	test for sos.physician
test.sos.poison	RFC 6881	test for sos.poison
test.sos.police	RFC 6881	test for sos.police

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