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Requirements for Emergency Context Resolution with Internet Technologies
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Abstract

This document defines terminology and enumerates requirements for the context resolution of emergency calls placed by the public using voice-over-IP (VoIP) and general Internet multimedia systems, where Internet protocols are used end-to-end.

Table of Contents

1. Introduction

Users of both voice-centric (telephone-like) and non-voice services such as text communication for hearing disabled users (RFC 3351 [RFC3351]) expect to be able to initiate a request for help in case of an emergency.

Unfortunately, the existing mechanisms to support emergency calls that have evolved within the public circuit-switched telephone network (PSTN) are not appropriate to handle evolving IP-based voice, text and real-time multimedia communications. This document outlines the key requirements that IP-based end systems and network elements, such as Session Initiation Protocol (SIP) [RFC3261] proxies, need to satisfy in order to provide emergency call services, which at a minimum, offer the same functionality as existing PSTN services, with the additional overall goal of making emergency calling more robust, less costly to implement, and multimedia-capable.

This document only focuses on end-to-end IP-based calls, i.e., where the emergency call originates from an IP end system and terminates in an IP-capable PSAP, conveyed entirely over an IP network.

We first define terminology in Section 3. The document then outlines various functional issues which relate to placing an IP-based emergency call, including a description of baseline requirements (Section 5), identification of the emergency caller's location (Section 6), use of a service identifier to declare a call to be an emergency call (Section 7), and finally, the mapping function required to route the call to the appropriate PSAP (Section 8).

The primary purpose of the mapping protocol is to produce a PSAP URI drawn from a preferred set of URI schemes such as SIP or SIPS URIs, based on both location information [RFC4119] and a service identifier in order to facilitate the IP end-to-end completion of an emergency call.

Aside from obtaining a PSAP URI, the mapping protocol is useful for obtaining other information as well. There may be a case, for example, where an appropriate emergency number is not known, only location. The mapping protocol can then return a geographically appropriate emergency number based on the input.

Since some PSAPs may not immediately support IP, or because some user equipment (UE) may not initially support emergency service identifiers, it may be necessary to also support emergency service identifiers that utilize less preferred URI schemes, such as a tel URI in order to complete an emergency call via the PSTN.

Identification of the caller, while not incompatible with the requirements for messaging outlined within this document, is considered to be outside the scope of this document.

Location is required for two separate purposes, first, to support the routing of the emergency call to the appropriate PSAP and second, to display the caller's location to the call taker to help in dispatching emergency assistance to the appropriate location.

This latter use, the display of location information to the PSAP, is orthogonal to the mapping protocol, and is outside the scope of this document.

2. Requirements Terminology

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in RFC 2119 [RFC2119], with the important qualification that, unless otherwise stated, these terms apply to the design of the mapping protocol, not its implementation or application.

3. Terminology

3.1. Emergency Services

Basic emergency service: Basic emergency service allows a caller to reach a PSAP serving its current location, but the PSAP may not be able to determine the identity or geographic location of the caller, except by the call taker asking the caller.

Enhanced emergency service: In enhanced emergency service, the PSAP call taker can determine the caller's current location.

3.2. Service Providers

Internet Access Provider (IAP): An organization that provides

physical and data link (layer 2) network connectivity to its customers or users, e.g., through digital subscriber lines, cable TV plants, Ethernet, leased lines or radio frequencies. Examples of such organizations include telecommunication carriers, municipal utilities, larger enterprises with their own network infrastructure, and government organizations such as the military.

Internet Service Provider (ISP): An organization that provides IP network-layer services to its customers or users. This entity may or may not provide the physical-layer and data link (layer-2) connectivity, such as fiber or Ethernet, i.e., it may or may not play the role of an IAP.

Application Service Provider (ASP): The organization or entity that provides application-layer services, which may include voice (see "Voice Service Provider"). This entity can be a private individual, an enterprise, a government, or a service provider. An ASP is more general than a Voice Service Provider, since emergency calls may use other media beyond voice, including text and video. For a particular user, the ASP may or may not be the same organization as his IAP or ISP.

Voice Service Provider (VSP): A specific type of Application Service Provider which provides voice related services based on IP, such as call routing, a SIP URI, or PSTN termination. In this document, unless noted otherwise, any reference to "Voice Service Provider" or "VSP" may be used interchangeably with "Application/ Voice Service Provider" or "ASP/VSP".

3.3. Actors

(Emergency) caller: The term "caller" or "emergency caller" refer to the person placing an emergency call or sending an emergency instant message (IM).

User Equipment (UE): User equipment is the device or software operated by the caller to place an emergency call. A SIP user

agent (UA) is an example of a UE.

Call taker: A call taker is an agent at the PSAP that accepts calls and may dispatch emergency help. Sometimes the functions of call taking and dispatching are handled by different groups of people, but these divisions of labor are not generally visible to the caller and thus do not concern us here.

3.4. Call Routing Entities

Emergency Service Routing Proxy (ESRP): An ESRP is an emergency call routing support entity that invokes the location-to-PSAP URI mapping function, to return an appropriate PSAP URI, or the URI for another ESRP. Client mapping requests could also be performed by a number of entities, including entities that instantiate the SIP proxy role and the SIP user agent client role.

Public Safety Answering Point (PSAP): Physical location where emergency calls are received under the responsibility of a public authority. (This terminology is used by both ETSI, in ETSI SR 002 180, and NENA.) In the United Kingdom, PSAPs are called Operator Assistance Centres, in New Zealand, Communications Centres. Within this document, it is assumed, unless stated otherwise, that PSAPs support the receipt of emergency calls over IP, using appropriate application layer protocols such as SIP for call signaling and RTP for media.

3.5. Location

Location: A geographic identification assigned to a region or feature based on a specific coordinate system, or by other precise information such as a street number and name. It can be either a civic or geographic location.

Civic location: A described location based on some reference system, such as jurisdictional region or postal delivery grid. A street address is a common example of a civic location.

Geographic location: A reference to a point which is able to be

located as described by a set of defined coordinates within a geographic coordinate system, such as latitude and longitude within the WGS-84 datum. For example, 2-D geographic location is defined as an (x,y) coordinate value pair according to the distance north or south of the equator and east or west of the prime meridian.

Location validation: A caller location is considered valid if the civic or geographic location is recognizable within an acceptable location reference system (e.g., United States Postal Address or the WGS-84 datum) and can be mapped to one or more PSAPs. While it is desirable to determine that a location exists, validation may not ensure that such a location exists, but rather may only ensure that the location falls within some range of known values. Location validation ensures that a location is able to be referenced for mapping, but makes no assumption about the association between the caller and the caller's location.

3.6. Identifiers, Numbers and Dial Strings

(Emergency) service number: The (emergency) service number is a string of digits used to reach the (emergency) service. The emergency service number is often just called the emergency number. It is the number typically dialed on devices directly connected to the PSTN and the number reserved for emergency calls by national or regional numbering authorities. It only contains the digits 0 through 9, # and *. The service number may depend on the location of the caller. For example, the general emergency service number in the United States is 911 and the poison control service number is 18002221222. In most cases, the service number and dial string are the same; they may differ in some private phone networks. A service number may be carried in tel URLs [RFC3966], along with a context identifier. In the North American numbering plan, some service numbers are also three-digit N11 or service codes, but not all emergency numbers have three digits. A caller may have to dial a service dial string (below) that differs from the service number when using a PBX.

(Emergency) service dial string: The service dial string identifies the string of digits that a caller must dial to reach a particular (emergency) service. In devices directly connected to the PSTN, the service dial string is the same as the service number and may thus depend on the location of the caller. However, in private phone networks, such as in PBXs, the service dial string consists of a dialing prefix to reach an outside line, followed by the emergency number. For example, in a hotel, the dial string for emergency services in the United States might be 9911. Dial

strings may contain indications of pauses or wait-for-secondary-dial-tone indications. Service dial strings are outside the scope of this document.

(Emergency) service identifier: The (emergency) service identifier describes the emergency service, independent of the user interface mechanism, the signaling protocol that is used to reach the service, or the caller's geographic location. It is a protocol constant and used within the mapping and signaling protocols. An example is the service URN [I-D.ietf-ecrit-service-urn].

(Emergency) service URL: The service URL is a protocol-specific (e.g., SIP) or protocol-agnostic (e.g., im: [RFC3860]) identifier which contains the address of the PSAP or other emergency service. It depends on the specific signaling or data transport protocol used to reach the emergency service.

Service URN: A service URN is an implementation of a service identifier, which can be applied to both emergency and non-emergency contexts, e.g., urn:service:sos or urn:service:counseling. Within this document, service URNs are referred to as 'emergency service URNs' [I-D.ietf-ecrit-service-urn].

Home emergency number: A home emergency number is the emergency number valid at the caller's customary home location, e.g., his permanent residence. The home location may or may not coincide with the service area of the caller's VSP.

Home emergency dial string: A home dial string is the dial string valid at the caller's customary home location, e.g., his permanent residence.

Visited emergency number: A visited emergency number is the emergency number valid at the caller's current physical location. We distinguish the visited emergency number if the caller is traveling outside his home region.

Visited emergency dial string: A visited emergency dial string is the dial string number valid at the caller's current physical location.

3.7. Mapping

Mapping: Mapping is the process of resolving a location to one or more PSAP URIs which directly identify a PSAP, or point to an intermediary which knows about a PSAP and that is designated as responsible for serving that location.

Mapping client: A mapping client interacts with the mapping server to learn one or more PSAP URIs for a given location.

Mapping protocol: A protocol used to convey the mapping request and response.

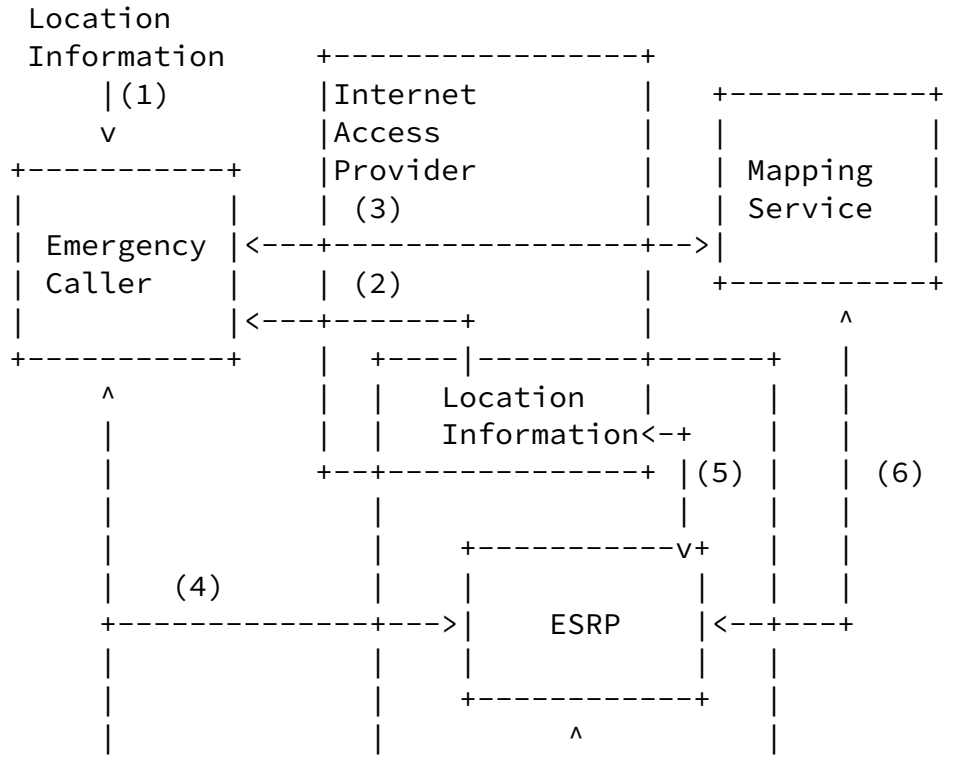
Mapping server: The mapping server holds information about the location-to-PSAP URI mapping.

Mapping service: A network service which uses a distributed mapping protocol to perform a mapping between a location and a PSAP, or intermediary which knows about the PSAP, and is used to assist in routing an emergency call.

4. Basic Actors

In order to support emergency services covering a large physical area, various infrastructure elements are necessary, including Internet Access Providers (IAPs), Application/Voice Service Providers (ASP/VSPs), Emergency Service Routing Proxy (ESRP) providers, mapping service providers, and PSAPs.

This section outlines which entities will be considered in the routing scenarios discussed.



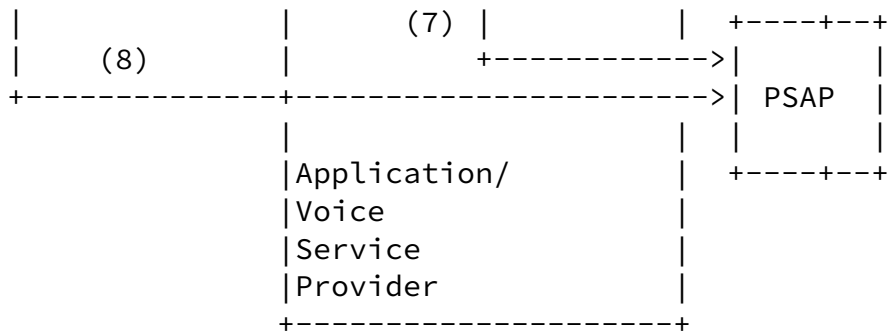


Figure 1: Framework for emergency call routing

Figure 1 shows the interaction between the entities involved in the call. There are a number of different deployment choices, as can be easily seen from the figure.

Is the Internet Access Provider also the Application/Voice Service Provider? In the Internet today these roles are typically provided by different entities. As a consequence, the Application/Voice Service Provider is typically not able to directly determine the physical location of the emergency caller.

The overlapping squares in the figure indicate that some functions can be collapsed into a single entity. As an example, the Application/Voice Service Provider might be the same entity as the Internet Access Provider. There is, however, no requirement that this must be the case. Additionally, we consider that end systems might act as their own ASP/VSP, e.g., either for enterprises or for residential users.

Various potential interactions between the entities depicted in Figure 1 are described below:

1. Location information might be available to the end host itself.

2. Location information might, however, also be obtained from the Internet Access Provider.

3. The emergency caller might need to consult a mapping service to determine the PSAP (or other relevant information) that is appropriate for the physical location of the emergency caller,

possibly considering other attributes such as appropriate language support by the emergency call taker.

4. The emergency caller might get assistance for emergency call routing by infrastructure elements that are emergency call routing support entities, such as an Emergency Service Routing Proxy (ESRP) in SIP.

5. Location information is used by emergency call routing support entities for subsequent mapping requests.

6. Emergency call routing support entities might need to consult a mapping service to determine where to route the emergency call.

7. For infrastructure-based emergency call routing (in contrast to UE-based emergency call routing), the emergency call routing support entity needs to forward the call to the PSAP.

8. The emergency caller may interact directly with the PSAP, where the UE invokes mapping, and initiates a connection, without relying on any intermediary emergency call routing support entities.

5. High-Level Requirements

Below, we summarize high-level architectural requirements that guide some of the component requirements detailed later in the document.

Re1. Application/Voice service provider existence: The initiation of an IP-based emergency call SHOULD NOT assume the existence of an Application/Voice Service Provider (ASP/VSP).

Motivation: The caller may not have an application/voice service provider. For example, a residence may have its own DNS domain and run its own SIP proxy server for that domain. On a larger scale, a university might provide voice services to its students and staff, but might not be a telecommunication provider.

Re2. International applicability: Regional, political and organizational aspects MUST be considered during the design of protocols and protocol extensions which support IP-based emergency

calls.

Motivation: It must be possible for a device or software developed or purchased in one country to place emergency calls in another country. System components should not be biased towards a particular set of emergency numbers or languages. Also, different countries have evolved different ways of organizing emergency services, e.g., either centralizing them or having smaller regional subdivisions such as United States counties or municipalities handle emergency calls within their jurisdiction.

Re3. Distributed administration: Deployment of IP-based emergency services MUST NOT depend on a single central administrative authority.

Motivation: The design of the mapping protocol must make it possible to deploy and administer emergency calling features on a regional or national basis without requiring coordination with other regions or nations. The system cannot assume, for example, that there is a single global entity issuing certificates for PSAPs, ASP/VSPs, IAPs or other participants.

Re4. Multi-mode communication: IP-based emergency calls MUST support multiple communication modes, including, for example, audio, video and text.

Motivation: Within the PSTN, voice and text telephony (often called TTY or text-phone in North America) are the only commonly supported media. Emergency calling must support a variety of media. Such media should include voice, conversational text (RFC

4103 [RFC4103]), instant messaging and video.

Re5. Mapping result usability: The mapping protocol MUST return one or more URIs that are usable within a standard signaling protocol (i.e., without special emergency extensions).

Motivation: For example, a SIP URI which is returned by the mapping protocol needs to be usable by any SIP capable phone within a SIP initiated emergency call. This is in contrast to a "special purpose" URI, which may not be recognizable by a legacy SIP device.

Re6. PSAP URI accessibility: The mapping protocol MUST support interaction between the client and server where no enrollment to a mapping service exists or is required.

Motivation: The mapping server may well be operated by a service provider, but access to the server offering the mapping must not require use of a specific ISP or ASP/VSP.

Re7. Common data structures and formats: The mapping protocol SHOULD support common formats for location data.

Motivation: Location databases should not need to be transformed or modified in any unusual or unreasonable way in order for the mapping protocol to use the data. For example, a database which contains civic addresses used by location servers may be used for multiple purposes and applications beyond emergency service location-to-PSAP URI mapping.

Re8. Anonymous mapping: The mapping protocol MUST NOT require the true identity of the target for which the location information is attributed.

Motivation: Ideally, no identity information is provided via the mapping protocol. Where identity information is provided, it may be in the form of an unlinked pseudonym (RFC 3693 [RFC3693]).

6. Identifying the Caller's Location

Location can either be provided directly (by value), or via a pointer (by reference), and represents either a civic location, or a

geographic location. An important question is how and when to attach location information to the VoIP emergency signaling messages. In general, we can distinguish three modes of operation of how a location is associated with an emergency call:

UA-inserted: The caller's user agent inserts the location information into the call signaling message.

UA-referenced: The caller's user agent provides a pointer (i.e., a location reference), via a permanent or temporary identifier, to the location information, which is stored by a location server somewhere else and then retrieved by the PSAP, ESRP, or other authorized entity.

Proxy-inserted: A proxy along the call path inserts the location or location reference.

The following requirements apply:

Lo1. Reference datum: The mapping protocol MUST support the WGS-84 coordinate reference system and MAY support other coordinate reference systems.

Motivation: Though many different datums exist around the world, this document recommends the WGS-84 datum since it is designed to describe the whole earth, rather than a single continent or other region, and is commonly used to represent Global Positioning System coordinates.

Lo2. Location delivery by-value: The mapping protocol MUST support the delivery of location information using a by-value method, though it MAY also support de-referencing a URL that references a location object.

Motivation: The mapping protocol is not required to support the ability to de-reference specific location references.

Lo3. Alternate community names: The mapping protocol MUST support both the jurisdictional community name and the postal community name fields within the PIDF-LO [RFC4119] data.

Motivation: The mapping protocol must accept queries with either a postal or jurisdictional community name field, or both, and provide appropriate responses. If a mapping query contains only one community name and the database contains both jurisdictional and postal community names, the mapping protocol response SHOULD return both community names.

Lo4. Validation of civic location: The mapping protocol MUST support location validation for civic locations (street addresses).

Motivation: Location validation provides an opportunity to help ascertain ahead of time whether or not a successful mapping to the appropriate PSAP will likely occur when it is required. Validation may also help to avoid delays during emergency call setup due to invalid location data.

Lo5. Information about location data used for mapping: The mapping protocol MUST support the ability to provide ancillary information about the resolution of location data used to retrieve a PSAP URI.

Motivation: The mapping server may not use all the data elements in the provided location information to determine a match, or may be able to find a match based on all of the information except for some specific data elements. The uniqueness of this information set may be used to differentiate among emergency jurisdictions. Precision or resolution in the context of this requirement might mean, for example, explicit identification of the data elements that were used successfully in the mapping.

Lo6. Contact for location problems: The mapping protocol MUST support a mechanism to contact an appropriate authority to resolve mapping-related issues for the queried location. For example, the querier may want to report problems with the response values or indicate that the mapping database is mistaken on declaring a civic location as non-existent.

Motivation: Initially, authorities may provide URLs where a human user can report problems with an address or location. In addition, web services may be defined to automate such reporting. For example, the querier may wish to report that the mapping database may be missing a newly-built or renamed street or house number.

Lo7. Limits to validation: Successful validation of a civic location MUST NOT be required to place an emergency call.

Motivation: In some cases, a civic location may not be considered valid. This fact should not result in the call being dropped or rejected by any entity along the call setup signaling path to the PSAP.

Lo8. 3D sensitive mapping: The mapping protocol MUST implement support for both 2D and 3D location information, and may accept either a 2D or 3D mapping request as input.

Motivation: It is expected that queriers may provide either 2D or 3D data. When a 3D request is presented within an area only defined by 2D data within the mapping server, the mapping result would be the same as if the height or altitude coordinate had been omitted from the mapping request.

Lo9. Database type indicator: The mapping protocol MAY support a mechanism which provides an indication describing a specific type of location database used.

Motivation: It is useful to know the source of the data stored in the database used for location validation, either for civic or geographic location matching. In the United States, sources of data could include the United States Postal Service, the Master Street Address Guide (MSAG) or commercial map data providers.

7. Emergency Service Identifier

Emergency service identifiers are protocol constants that allow protocol entities such as SIP proxy servers to distinguish emergency calls from non-emergency calls and to identify the specific emergency service desired. Emergency service identifiers are a subclass of service identifiers that more generally identify services reachable by callers. An example of a service identifier is the service URN [I-D.ietf-ecrit-service-urn], but other identifiers, such as tel URIs [RFC3966], may also serve this role during a transition period.

Since this document only addresses emergency services, we use the terms "emergency service identifier" and "service identifier" interchangeably. Requirements for these identifiers include:

Id1. Multiple emergency services: The mapping protocol MUST be able to distinguish between different emergency services, differentiated by different service identifiers.

Motivation: Some jurisdictions may offer multiple types of emergency services that operate independently and can be contacted directly, for example, fire, police and ambulance services.

Id2. Extensible emergency service identifiers: The mapping protocol MUST support an extensible list of emergency identifiers, though it is not required to provide mappings for every possible service.

Motivation: Extensibility is required since new emergency services may be introduced over time, either globally or in some jurisdictions. The availability of emergency services depends on the locations. For example, the Netherlands are unlikely to offer a mountain rescue service.

Id3. Discovery of emergency number: The mapping protocol MUST be able to return the location-dependent emergency number for the location indicated in the query.

Motivation: Users are trained to dial the appropriate emergency number to reach emergency services. There needs to be a way to figure out the emergency number at the current location of the caller.

Id4. Home emergency number recognition: User equipment MUST be able to translate a home emergency number into an emergency service identifier.

Motivation: The UE could be pre-provisioned with the appropriate information in order to perform such a translation or could discover the emergency number by querying the mapping protocol with its home location.

Id5. Emergency number replacement: There SHOULD be support for replacement of the emergency number with the appropriate emergency service identifier for each signaling protocol used for an emergency call, based on local conventions, regulations, or preference (e.g., as in the case of an enterprise).

Motivation: Any signaling protocol requires the use of some identifier to indicate the called party, and the user equipment may lack the capability to determine the actual service URL (PSAP URI). The use of local conventions may be required as a transition mechanism. Since relying on recognizing local numbering conventions makes it difficult for devices to be used outside their home context and for external devices to be introduced into a network, protocols should use standardized emergency service identifiers.

Id6. Emergency service identifier marking: Signaling protocols MUST support emergency service identifiers to mark a call as an emergency call.

Motivation: Marking ensures proper handling as an emergency call

by downstream elements that may not recognize, for example, a local variant of a logical emergency address. This marking mechanism is related to, but independent of, marking calls for prioritized call handling [RFC4412].

Id7. Handling unrecognized emergency service identifiers: There MUST be support for calls which are initiated as emergency calls even if the specific emergency service requested is not recognized by the ESRP. Such calls will then be routed to a generic emergency service.

Motivation: Fallback routing allows new emergency services to be introduced incrementally, while avoiding non-routable emergency calls. For example, a call for marine rescue services would be routed to a general PSAP if the caller's location does not offer marine rescue services yet.

Id8. Return fallback service identifier: The mapping protocol must be able to report back the actual service mapped if the mapping protocol substitutes another service for the one requested.

Motivation: A mapping server may be configured to automatically look up the PSAP for another service if the user-requested service is not available for that location. For example, if there is no marine rescue service, the mapping protocol might return the PSAP URL for general emergencies and include the "urn:service.sos" identifier in the response to alert the querier to that fact.

Id9. Discovery of visited emergency numbers: There MUST be a mechanism to allow the end device to learn visited emergency numbers.

Motivation: Travelers visiting a foreign country may observe the local emergency number, e.g., seeing it painted on the side of a fire truck, and then rightfully expect to be able to dial that emergency number. Similarly, a local "good Samaritan" may use a tourist's cell phone to summon help.

8. Mapping Protocol

There are two basic approaches to invoke the mapping protocol. We refer to these as caller-based and mediated. In each case, the mapping client initiates a request to a mapping server via a mapping protocol. A proposed mapping protocol, LoST, is outlined in [I-D.hardie-ecrit-lost].

For caller-based resolution, the caller's user agent invokes the mapping protocol to determine the appropriate PSAP based on the location provided. The resolution may take place well before the actual emergency call is placed, or at the time of the call.

For mediated resolution, an emergency call routing support entity, such as a SIP (outbound) proxy or redirect server invokes the mapping service.

Since servers may be used as outbound proxy servers by clients that are not in the same geographic area as the proxy server, any proxy server has to be able to translate any caller location to the appropriate PSAP. (A traveler may, for example, accidentally or intentionally configure its home proxy server as its outbound proxy server, even while far away from home.)

Ma1. Baseline query protocol: A mandatory-to-implement protocol MUST be specified.

Motivation: An over-abundance of similarly-capable choices appears undesirable for interoperability.

Ma2. Extensible protocol: The mapping protocol MUST be designed to support the extensibility of location data elements, both for new and existing fields.

Motivation: This is needed, for example, to accommodate future extensions to location information that might be included in the PIDF-LO ([RFC4119]).

Ma3. Incrementally deployable: The mapping protocol MUST be designed to support its incremental deployment.

Motivation: It must not be necessary, for example, to have a global street level database before deploying the system. It is acceptable to have some misrouting of calls when the database does not (yet) contain accurate PSAP service area information.

Ma4. Any time mapping: The mapping protocol MUST support the ability of the mapping function to be invoked at any time, including while an emergency call is in process and before an emergency call is initiated.

Motivation: Used as a fallback mechanism only, if a mapping query fails at emergency call time, it may be advantageous to have prior knowledge of the PSAP URI. This prior knowledge would be obtained by performing a mapping query at any time prior to an emergency call.

Ma5. Anywhere mapping: The mapping protocol MUST support the ability to provide mapping information in response to an individual query from any (earthly) location, regardless of where the mapping client is located, either geographically or by network location.

Motivation: The mapping client, such as an ESRP, may not necessarily be anywhere close to the caller or the appropriate PSAP, but must still be able to obtain mapping information.

Ma6. Appropriate PSAP: The mapping protocol MUST support the routing of an emergency call to the PSAP responsible for a particular geographic area.

Motivation: Routing to the wrong PSAP will result in delays in handling emergencies as calls are redirected, and therefore will also result in inefficient use of PSAP resources at the initial point of contact. It is important that the location determination mechanism not be fooled by the location of IP telephony gateways or dial-in lines into a corporate LAN (and dispatch emergency help to the gateway or campus, rather than the caller), multi-site LANs and similar arrangements.

Ma7. Multiple PSAP URIs: The mapping protocol MUST support a method to return multiple PSAP URIs which cover the same geographic area.

Motivation: Different contact protocols (e.g., PSTN via tel URIs and IP via SIP URIs) may be routed to different PSAPs. Less likely, two PSAPs may overlap in their coverage region.

Ma8. Single primary URI per contact protocol: Though the mapping protocol may be able to include multiple URIs in the response, it SHOULD return only one primary URI per contact protocol used, so that clients are not required to select among different targets for the same contact protocol.

Motivation: There may be two or more URIs returned when multiple contact protocols are available (e.g., SIP and SMS). The client may select among multiple contact protocols based on its capabilities, preference settings, or availability.

Ma9. Non-preferred URI schemes: The mapping protocol MAY support the return of a less preferred URI scheme, such as a tel URI.

Motivation: In order to provide incremental support to non-IP PSAPs it may be necessary to be able to complete an emergency call via the PSTN.

Ma10. URI properties: The mapping protocol MUST support the ability to provide ancillary information about a contact that allows the mapping client to determine relevant properties of the PSAP URI.

Motivation: In some cases, the same geographic area is served by several PSAPs, for example, a corporate campus might be served by both a corporate security department and the municipal PSAP. The mapping protocol should then return URIs for both, with information allowing the querying entity to choose one or the other. This determination could be made by either an ESRP, based on local policy, or by direct user choice, in the case of caller-based methods.

Ma11. Mapping referral: The mapping protocol MUST support a mechanism for the mapping client to contact any mapping server and be referred to another mapping server that is more qualified to answer the query.

Motivation: Referrals help mitigate the impact of incorrect configuration that directs a client to the wrong initial mapping server.

Ma12. Split responsibility: The mapping protocol MUST support the division of data subset handling between multiple mapping servers within a single level of a civic location hierarchy.

Motivation: For example, two mapping servers for the same city or county may handle different streets within that city or county.

Ma13. URL for error reporting: The mapping protocol MUST support the ability to return a URL that can be used to report a suspected or known error within the mapping database.

Motivation: If an error is returned, for example, there needs to be a URL which points to a resource which can explain or potentially help resolve the error.

Ma14. Resilience to mapping server failure: The mapping protocol MUST support a mechanism which enables the client to fail over to different (replica) mapping server.

Motivation: The failure of a mapping server should not preclude the mapping client from receiving an answer to its query.

Ma15. Traceable resolution: The mapping protocol SHOULD support the ability of the mapping client to be able to determine the entity or entities that provided the emergency address resolution information.

Motivation: To improve reliability and performance, it is important to be able to trace which servers contributed to the resolution of a query.

Ma16. Minimal additional delay: Mapping protocol execution SHOULD minimize the amount of delay within the overall call-setup time.

Motivation: Since outbound proxies will likely be asked to resolve the same geographic coordinates repeatedly, a suitable time-limited caching mechanism should be supported.

Ma17. Freshness indication: The mapping protocol SHOULD support an indicator describing how current the information provided by the mapping source is.

Motivation: This is especially useful when an alternate mapping is requested, and alternative sources of mapping data may not have been created or updated with the same set of information or within the same timeframe. Differences in currency between mapping data contained within mapping sources should be minimized.

9. Security Considerations

Threats and security requirements are discussed in a separate document [I-D.ietf-ecrit-security-threats].

10. IANA Considerations

This document does not require actions by the IANA.

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