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Location Conveyance for the Session Initiation Protocol
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Abstract

This document defines an extension to the Session Initiation Protocol (SIP) to convey geographic location information from one SIP entity to another SIP entity. The SIP extension covers end-to-end conveyance as well as location-based routing, where SIP intermediaries make routing decisions based upon the location of the Location Target.

Status of this Memo

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1. Conventions and Terminology used in this document

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 [RFC2119]. This document furthermore uses numerous terms defined in RFC 3693 [RFC3693], including Location Object, Location Recipient, Location Server, Target, and Using Protocol.

2. Introduction

Session Initiation Protocol (SIP) [RFC3261] creates, modifies and terminates multimedia sessions. SIP carries certain information related to a session while establishing or maintaining calls. This document defines how SIP conveys geographic location information of a Target to a Location Recipient (LR). SIP acts as a Using Protocol of location information, as defined in RFC 3693.

In order to convey location information, this document specifies three new SIP header fields, Geolocation, Geolocation-Routing and Geolocation-Error, which carry a reference to a Location Object (LO), grant permission to route a SIP request based on the location-value and provide error notifications specific to location errors respectively. The Location Object (LO) may appear in a MIME body attached to the SIP request, or it may be a remote resource in the network.

A Target is an entity whose location is being conveyed, per RFC 3693. Thus, a Target could be a SIP user agent (UA), some other IP device (a router or a PC) that does not have a SIP stack, a non-IP device (a person or a black phone) or even a non-communications device (a building or store front). In no way does this document assume that the SIP user agent client which sends a request containing a location object is necessarily the Target. The location of a Target conveyed within SIP typically corresponds to that of a device controlled by the Target, for example, a mobile phone, but such devices can be separated from their owners, and moreover, in some cases the user agent may not know its own location.

In the SIP context, a location recipient will most likely be a SIP UA, but due to the mediated nature of SIP architectures, location information conveyed by a single SIP request may have multiple

recipients, as any SIP proxy server in the signaling path that inspects the location of the Target must also be considered a Location Recipient. In presence-like architectures, an intermediary

that receives publications of location information and distributes them to watchers acts as a Location Server per RFC 3693. This location conveyance mechanism can also be used to deliver URIs pointing to such Location Servers where prospective Location Recipients can request Location Objects.

3. Overview of SIP Location Conveyance

An operational overview of SIP location conveyance can be shown in 4 basic diagrams, with most applications falling under one of the following basic use cases. Each is separated into its own subsection here in section 3.

Each diagram has Alice and Bob as UAs. Alice is the Target, and Bob is an LR. A SIP intermediary appears in some of the diagrams. Any SIP entity that receives and inspects location information is an LR, therefore any of the diagrams the SIP intermediary receives the SIP request is potentially an LR - though that does not mean such an intermediary necessarily has to route the SIP request based on the location information. In some use cases, location information passes through the LS on the right of each diagram.

3.1 Location Conveyed by Value

We start with the simplest diagram of Location Conveyance, Alice to Bob, where no other layer 7 entities are involved.

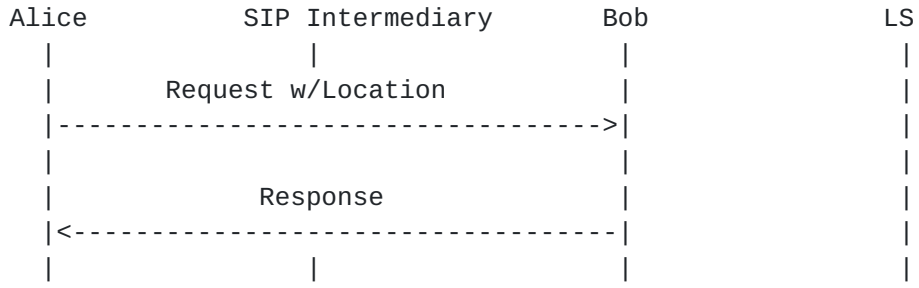

Figure 1. Location Conveyed by Value

In Figure 1, Alice is both the Target and the LS that is conveying her location directly to Bob, who acts as an LR. This conveyance is point-to-point - it does not pass through any SIP-layer intermediary. A Location Object appears by-value in the initial SIP request as a MIME body, and Bob responds to that SIP request as appropriate. There is a 'Bad Location Information' response code introduced within this document to specifically inform Alice if she conveys bad location to Bob (e.g., Bob "cannot parse the location provided", or "there is not enough location information to determine where Alice is").

3.2 Location Conveyed as a Location URI

Here we make Figure 1 a little more complicated by showing a diagram of indirect Location Conveyance from Alice to Bob, where Bob's entity has to retrieve the location object from a 3rd party server.

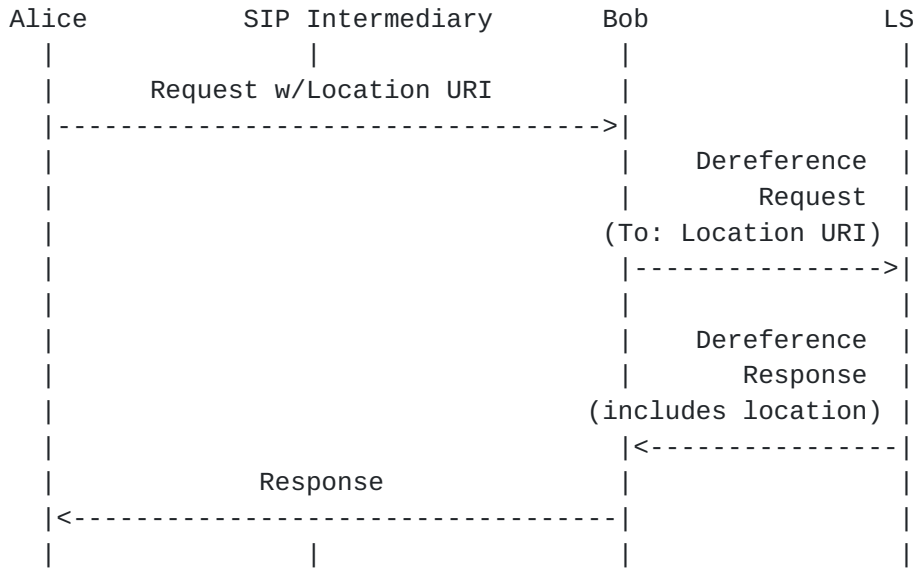

Figure 2. Location Conveyed as a Location URI

In Figure 2, location is conveyed indirectly, via a Location URI carried in the SIP request (more of those details later). If Alice sends Bob this Location URI, Bob will need to dereference the URI - analogous to Content Indirection [RFC4483] - in order to request the location information. In general, the LS provides the location value to Bob instead of Alice directly for conveyance to Bob. From a user interface perspective, Bob the user won't know that this information was gathered from an LS indirectly rather than culled from the SIP request, and practically this does not impact the operation of location-based applications.

The example given in this section is only illustrative, not normative. In particular, applications can choose to dereference a location URI at any time, possibly several times, or potentially not at all. Applications receiving a Location URI in a SIP transaction need to be mindful of timers used by different transactions. In particular, if the means of dereferencing the Location URI might take longer than the SIP transaction timeout (Timer C for INVITE transactions, Timer F for non-INVITE transactions), then it needs to rely on mechanisms other than the transaction's response code to convey location errors, if returning such errors are necessary.

3.3 Location Conveyed though a SIP Intermediary

In Figure 3, we introduce the idea of a SIP intermediary into the example to illustrate the role of proxying in the location architecture. This intermediary can be a SIP proxy or it can be a back-to-back-user-agent (B2BUA). In this message flow, the SIP intermediary could act as a LR, in addition to Bob. The primary use case for intermediaries consuming location information is location-based routing. In this case, the intermediary chooses a next hop for the SIP request by consulting a specialized location service which selects forwarding destinations based on geographical location.

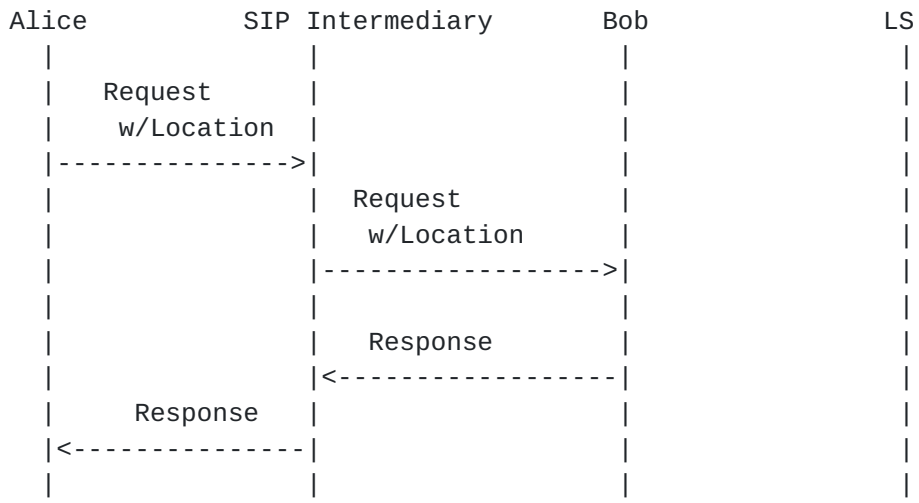

Figure 3. Location Conveyed though a SIP Intermediary

However, the most common case will be one in which the SIP intermediary receives a request with location information (conveyed either by-value or by-reference) and does not know or care about Alice's location, or support this extension, and merely passes it on to Bob. In this case, the intermediary does not act as a Location Recipient. When the intermediary is not an LR, this use case is the same as the one described in Section 3.1.

Note that an intermediary does not have to perform location-based routing in order to be location recipient. It could be the case that a SIP intermediary which does not perform location-based routing but does care when Alice includes her location; for example, it could care that the location information is complete or that it correctly identifies where Alice is. The best example of this is intermediaries that verify location information for emergency calling, but it could also be for any location based routing - e.g., contacting your favorite local pizza delivery service, making sure that organization has Alice's proper location in the initial SIP request.

There is another scenario in which the SIP intermediary cares about

location and is not an LR, one in which the intermediary inserts another location of the Target, Alice in this case, into the request, and forwards it. This secondary insertion is generally not

advisable because downstream SIP entities will not be given any guidance about which location to believe is better, more reliable, less prone to error, more granular, worse than the other location or just plain wrong.

This document takes a "you break it, you bought it" approach to dealing with second locations placed into a SIP request by an intermediary entity. That entity becomes completely responsible for all location within that SIP request (more on this in Section 4).

3.4 SIP Intermediary Replacing Bad Location

If the SIP intermediary rejects the message due to unsuitable location information, the SIP response will indicate there was 'Bad Location Information' in the SIP request, and provide a location specific error code indicating what Alice needs to do to send an acceptable request (see Figure 4 for this scenario).

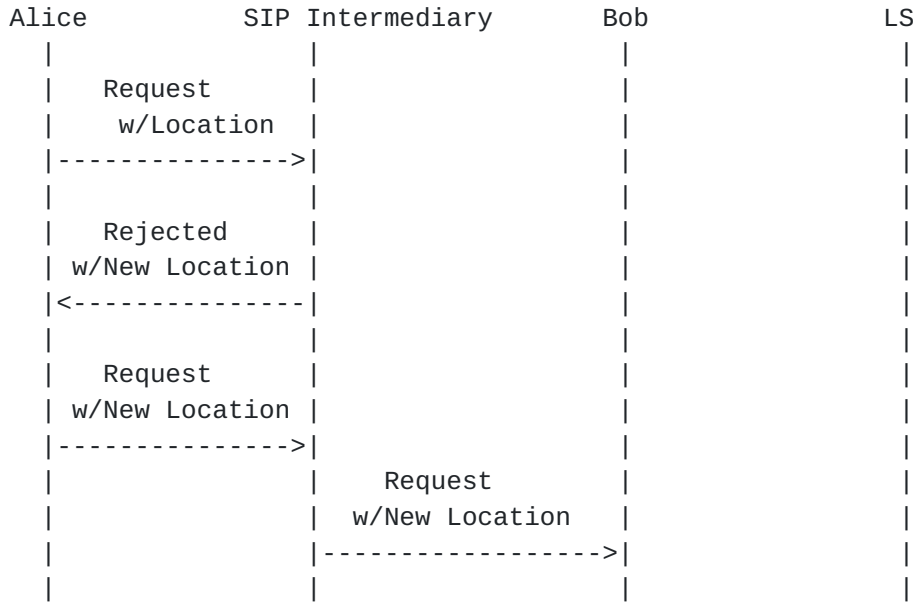

Figure 4. SIP Intermediary Replacing Bad Location

In this last use case, the SIP intermediary wishes to include a Location Object indicating where it understands Alice to be. Thus, it needs to inform her user agent what location it will include in any subsequent SIP request that contains her location. In this case, the intermediary can reject Alice's request and, through the SIP response, convey to her the best way to repair the request in order for the intermediary to accept it.

Overriding location information provided by the user requires a deployment where an intermediary necessarily knows better than an

end user - after all, it could be that Alice has an on-board GPS, and the SIP intermediary only knows her nearest cell tower. Which is more accurate location information? Currently, there is no way to

tell which entity is more accurate, or which is wrong - for that matter. This document will not specify how to indicate which location is more accurate than another.

As an aside, it is not envisioned that any SIP-based emergency services request (i.e., IP-911, or 112 type of call attempt) will receive a corrective 'Bad Location Information' response from an intermediary. Most likely, the SIP intermediary would in that scenario act as a B2BUA and insert into the request by-value any appropriate location information for the benefit of Public Safety Answering Point (PSAP) call centers to expedite call reception by the emergency services personnel; thereby, minimizing any delay in call establishment time. The implementation of these specialized deployments is, however, outside the scope of this document.

4. SIP Modifications for Geolocation Conveyance

The following sections detail the modifications to SIP for location conveyance.

4.1 The Geolocation Header Field

This document defines "Geolocation" as a new SIP header field registered by IANA, with the following ABNF [RFC5234]:

```
message-header    /= Geolocation-header ; (message-header from 3261)
Geolocation-header = "Geolocation" HCOLON locationValue
                     *( COMMA locationValue )
locationValue      =  LAQUOT locationURI RAQUOT
                       *(SEMI geoloc-param)
locationURI        =  sip-URI / sips-URI / pres-URI
                       / http-URI / https-URI
                       / cid-url ; (from RFC 2392)
                       / absoluteURI ; (from RFC 3261)
geoloc-param       =  generic-param;  (from RFC 3261)
```

HCOLON, COMMA, LAQUOT, RAQUOT, and SEMI are defined in RFC3261 [RFC3261].

sip-URI, sips-URI and absoluteURI are defined according to [RFC3261].

The pres-URI is defined in [RFC3859].

http-URI and https-URI are defined according to [RFC2616] and [RFC2818], respectively.

The cid-url is defined in [RFC2392] to locate message body parts. This URI type is present in a SIP request when location is conveyed as a MIME body in the SIP message.

GEO-URIs [RFC5870] are not appropriate for usage in the SIP

Geolocation header.

Other URI schemas used in the location URI MUST be reviewed against the RFC 3693 [RFC3693] criteria for a Using Protocol.

The generic-param in the definition of locationValue is included as a mechanism for future extensions that might require parameters. This document defines no parameters for use with locationValue. If a Geolocation header field is received that contains generic-params, each parameter SHOULD be ignored, and SHOULD NOT be removed when forwarding the locationValue. If a need arises to define parameters for use with locationValue, a revision/extension to this document is required.

The Geolocation header field can have one or more locationValues. A Geolocation header field MUST have at least one locationValue. A SIP intermediary SHOULD NOT add location to a SIP request that already contains location. This will quite often lead to confusion within LRs. However, if a SIP intermediary adds location, even if location was not previously present in a SIP request, that SIP intermediary is fully responsible for addressing the concerns of any 424 (Bad Location Information) SIP response it receives about this location addition, and MUST NOT pass on (upstream) the 424 response. A SIP intermediary that adds a locationValue MUST position the new locationValue as the last locationValue within the Geolocation header field of the SIP request.

This document defines the Geolocation header field as valid in the following SIP requests:

INVITE [RFC3261],	REGISTER [RFC3261],
OPTIONS [RFC3261],	BYE [RFC3261],
UPDATE [RFC3311],	INFO [RFC6086],
MESSAGE [RFC3428],	REFER [RFC3515],
SUBSCRIBE [RFC3265],	NOTIFY [RFC3265],
PUBLISH [RFC3903]	

The Geolocation header field MAY be included in any one of the above listed requests by a UA, and a 424 response to any one of the requests sent above. Fully appreciating the caveats/warnings mentioned above, a SIP intermediary MAY add the Geolocation header field.

A SIP intermediary MAY add a Geolocation header field if one is not present - for example, when a user agent does not support the Geolocation mechanism but their outbound proxy does and knows the Target's location, or any of a number of other use cases (see Section 3).

The Geolocation header field MAY be present in a SIP request or response without the presence of a Geolocation-Routing header (defined in Section 4.2). As stated in Section 4.2, the default

value of Geolocation-Routing header-value is "no", meaning SIP intermediaries are not to view any direct or indirect location within this SIP message.

Any locationValue MUST be related to the original Target. This is equally true the location information in a SIP response, i.e., from a SIP intermediary back to the Target as explained in Section 3.4.

SIP intermediaries SHOULD NOT modify or delete any existing locationValue(s).

4.2 The Geolocation-Routing Header Field

This document defines "Geolocation-Routing" as a new SIP header field registered by IANA, with the following ABNF [RFC5234]:

```
message-header    /= Georouting-header ; (message-header from 3261)
Georouting-header  = "Geolocation-Routing" HCOLON
                     ( "yes" / "no" / generic-value )
generic-value      =  generic-param;  (from RFC 3261)
```

HCOLON is defined in RFC3261 [RFC3261].

The only defined values for the Geolocation-Routing header field are "yes" or "no". When the value is "yes", the locationValue can be used for routing decisions along the downstream signaling path by intermediaries. Values other than "yes" or "no" are permitted for future extensions. Implementations not aware of an extension MUST treat any other received value the same as "no".

If no Geolocation-Routing header field is present in a SIP request, a SIP intermediary MAY insert this header. Without knowledge from a Rulemaker, the SIP intermediary inserting this header-value SHOULD NOT set the value to "yes", as this may be more permissive than the originating party intends. An easy way around this is to have the Target always insert this header-value as "no".

When this Geolocation-Routing header-value is set to "no", this means no locationValue (inserted by the originating UAC or any intermediary along the signaling path) can be used by any SIP intermediary to make routing decisions. Intermediaries that attempt to use the location information for routing purposes in spite of this counter indication could end up routing the request improperly as a result. Section 4.4 describes the details on what a routing intermediary does if it determines it needs to use the location in the SIP request in order to process the message further. The practical implication is that when the Geolocation-Routing header-value is set to "no", if a cid:url is present in the SIP request, intermediaries SHOULD NOT view the location (because it is

not for intermediaries to view), and if a location URI is present, intermediaries SHOULD NOT dereference it. UAs are allowed to view

location in the SIP request even when the Geolocation-Routing header-value is set to "no". An LR MUST by default consider the Geolocation-Routing header-value as set to "no", with no exceptions, unless the header field value is set to "yes".

A Geolocation-Routing header-value that is set to "no" has no special security properties. It is at most a request for behavior within SIP intermediaries. That said, if the Geolocation-Routing header-value is set to "no", SIP intermediaries are still to process the SIP request and send it further downstream within the signaling path if there are no errors present in this SIP request.

The Geolocation-Routing header field satisfies the recommendations made in section 3.5 of RFC 5606 [RFC5606] regarding indication of permission to use location-based routing in SIP.

SIP implementations are advised to pay special attention to the policy elements for location retransmission and retention described in RFC 4119.

The Geolocation-Routing header field cannot appear without a header-value in a SIP request or response (i.e., a null value is not allowed). The absence of a Geolocation-Routing header-value in a SIP request is always the same as the following header field:

```
Geolocation-Routing: no
```

The Geolocation-Routing header field MAY be present without a Geolocation header field in the same SIP request. This concept is further explored in Section 4.2.1.

4.2.1 Explaining Geolocation-Routing header-value States

The Geolocation header field contains a Target's location, and MUST NOT be present if there is no location information in this SIP request. The location information is contained in one or more locationValues. These locationValues MAY be contained in a single Geolocation header field, or distributed among multiple Geolocation header fields. (See section 7.3.1 of RFC3261.)

The Geolocation-Routing header field indicates whether or not SIP intermediaries can view and then route this SIP request based on the included (directly or indirectly) location information. The Geolocation-Routing header field MUST NOT appear more than once in any SIP request, and MUST NOT lack a header-value. The default or implied policy of a SIP request that does not have a Geolocation-Routing header field is the same as if one were present and the header-value were set to "no".

There are only 3 possible states regarding the Geolocation-Routing header field

- "no"
- "yes"
- no header-field present in this SIP request

The expected results in each state are:

If the Geolocation-Routing	Only possible interpretations:
"no"	Location viewing policy set already such that no intermediaries can view location inserted downstream. SIP intermediaries inserting a locationValue into a Geolocation header field (whether adding to an existing header-value or inserting the Geolocation header field for the first time) MUST NOT modify or delete the received "no" header-value.
"yes"	Location viewing policy set already such that if location is inserted downstream, intermediaries can maintain an open viewing of location policy or can change policy to "no" for intermediaries further downstream.
Geolocation-Routing absent	If a Geolocation header field exists (meaning a locationValue is already present), a SIP intermediary MUST interpret the lack of a Geolocation-Routing header field as if there were one present and the header-value is set to "no". If there is no Geolocation header field in this SIP request, the default Geolocation-Routing is open and can be set by a downstream entity or not at all.

4.3 424 (Bad Location Information) Response Code

This SIP extension creates a new location-specific response code, defined as follows,

424 (Bad Location Information)

The 424 (Bad Location Information) response code is a rejection of

the request due to its location contents, indicating location information that was malformed or not satisfactory for the recipient's purpose, or could not be dereferenced.

A SIP intermediary can also reject a location it receives from a Target when it understands the Target to be in a different location. The proper handling of this scenario, described in Section 3.4, is for the SIP intermediary to include the proper location in the 424 Response. This SHOULD be included in the response as a MIME message body (i.e., a location value), rather than as a URI; however, in cases where the intermediary is willing to share location with recipients but not with a user agent, a reference might be necessary.

As mentioned in Section 3.4, it might be the case that the intermediary does not want to chance providing less accurate location information than the user agent; thus it will compose its understanding of where the user agent is in a separate <geopriv> element of the same PIDF-LO message body in the SIP response (which also contains the Target's version of where it is). Therefore, both locations are included - each with different <method> elements. The proper reaction of the user agent is to generate a new SIP request that includes this composed location object, and send it towards the original LR. SIP intermediaries can verify that subsequent requests properly insert the suggested location information before forwarding said requests.

SIP intermediaries that are forwarding (as opposed to generating) a 424 response MUST NOT add, modify, or delete any location appearing in that response. This specifically applies to intermediaries that are between the 424 response generator and the original UAC. Geolocation and Geolocation-Error header fields and PIDF-LO body parts MUST remain unchanged, never added to or deleted.

Section 4.4 describes a Geolocation-Error header field to provide more detail about what was wrong with the location information in the request. This header field MUST be included in the 424 response.

It is only appropriate to generate a 424 response when the responding entity needs a locationValue and there are no values in the request that are usable by the responder, or when the responder has additional location information to provide. The latter case is shown in Figure 4 of section 3.4. There, a SIP intermediary is informing the upstream UA which location to include in the next SIP request.

A 424 MUST NOT be sent in response to a request that lacks a Geolocation header entirely, as the user agent in that case may not

support this extension at all. If a SIP intermediary inserted a locationValue into a SIP request where one was not previously present, it MUST take any and all responsibility for the corrective

action if it receives a 424 to a SIP request it sent.

A 424 (Bad Location Information) response is a final response within a transaction, and MUST NOT terminate an existing dialog.

4.4 The Geolocation-Error Header Field

As discussed in Section 4.3, more granular error notifications specific to location errors within a received request are required if the location inserting entity is to know what was wrong within the original request. The Geolocation-Error header field is used for this purpose.

The Geolocation-Error header field is used to convey location-specific errors within a response. The Geolocation-Error header field has the following ABNF [RFC5234]:

```
message-header          /= Geolocation-Error
                           ; (message-header from 3261)
Geolocation-Error        = "Geolocation-Error" HCOLON
                             locationErrorValue
locationErrorValue       = location-error-code
                            *(SEMI location-error-params)
location-error-code      = 1*3DIGIT
location-error-params    = location-error-code-text
                           / generic-param ; from RFC3261
location-error-code-text = "code" EQUAL quoted-string ; from RFC3261
```

HCOLON, SEMI, and EQUAL are defined in RFC3261 [RFC3261]. DIGIT is defined in RFC5234 [RFC5234].

The Geolocation-Error header field MUST contain only one locationErrorValue to indicate what was wrong with the locationValue the Location Recipient determined was bad. The locationErrorValue contains a 3-digit error code indicating what was wrong with the location in the request. This error code has a corresponding quoted error text string that is human understandable. The text string are OPTIONAL, but RECOMMENDED for human readability, similar to the string phrase used for SIP response codes. That said, the strings are complete enough for rendering to the user, if so desired. The strings in this document are recommendations, and are not standardized - meaning an operator can change the strings - but MUST NOT change the meaning of the error code. Similar to how RFC 3261 specifies, there MUST NOT be more than one string per error code.

The Geolocation-Error header field MAY be included in any response to one of the SIP Methods mentioned in Section 4.1, so long as a

locationValue was in the request part of the same transaction. For example, Alice includes her location in an INVITE to Bob. Bob can

accept this INVITE, thus creating a dialog, even though his UA determined the location contained in the INVITE was bad. Bob merely includes a Geolocation-Error header value in the 200 OK to the INVITE informing Alice the INVITE was accepted but the location provided was bad.

If, on the other hand, Bob cannot accept Alice's INVITE without a suitable location, a 424 (Bad Location Information) is sent. This message flow is shown in Figures 1, 2 or 3 in Sections 3.1, 3.2 and 3.3 respectively.

A SIP intermediary that requires Alice's location in order to properly process Alice's INVITE also sends a 424 with a Geolocation-Error code. This message flow is shown in Figure 4 of Section 3.4.

If more than one locationValue is present in a SIP request and at least one locationValue is determined to be valid by the LR, the location in that SIP request MUST be considered good as far as location is concerned, and no Geolocation-Error is to be sent.

Here is an initial list of location based error code ranges for any SIP response, including provisional responses (other than 100 Trying) and the new 424 (Bad Location Information) response. These error codes are divided into 3 categories, based on how the response receiver should react to these errors. There MUST be no more than one Geolocation-Error code in a SIP response, regardless of how many locationValues there are in the correlating SIP request. There is no guidance given in this document as to which locationValue, when more than one was present in the SIP request, is related to the Geolocation-Error code; meaning that, somehow not defined here, the LR just picks one to error.

- 1XX errors mean the LR cannot process the location within the request

  A non-exclusive list of reasons for returning a 1XX is

  - the location was not present or could not be found,
  - there was not enough location information to determine where the Target was,
  - the location information was corrupted or known to be inaccurate,

- 2XX errors mean some specific permission is necessary to process the included location information.

- 3XX errors mean there was trouble dereferencing the Location URI sent.

It should be noted that for non-INVITE transactions, the SIP response will likely be sent before the dereference response has

been received. This document does not alter that SIP protocol reality. This means the receiver of any non-INVITE response to a request containing location SHOULD NOT consider a 200 OK to mean the act of dereferencing has concluded and the dereferencer (i.e., the LR) has successfully received and parsed the PIDF-LO for errors and found none. The end of section 3.2 discusses how transaction timing considerations lead to this requirement.

Additionally, if an LR cannot or chooses not to process location from a SIP request, a 500 (Server Internal Error) SHOULD be used with or without a configurable Retry-After header field. There is no special location error code for what already exists within SIP today.

Within each of these ranges, there is a top level error as follows:

Geolocation-Error: 100 ; code="Cannot Process Location"

Geolocation-Error: 200 ; code="Permission To Use Location Information"

Geolocation-Error: 300 ; code="Dereference Failure"

If an error recipient cannot process an specific error code (such as the 201 or 202 below), perhaps because it does not understand that specific error code, the error recipient SHOULD process the error code as if it originally were a top level error code where the X in X00 matches the specific error code. If the error recipient cannot process a non-100 error code, for whatever reason, then the error code 100 MUST be processed.

There are two specific Geolocation-Error codes necessary to include in this document, both have to do with permissions necessary to process the SIP request; they are

Geolocation-Error: 201 ; code="Permission To Retransmit Location Information to a Third Party"

This location error is specific to having the Presence Information Data Format (PIDF-LO) [RFC4119] <retransmission-allowed> element set to "no". This location error is stating it requires permission (i.e., PIDF-LO <retransmission-allowed> element set to "yes") to process this SIP request further. If the LS sending the location information does not want to give this permission, it will not reset this permission in a new request. If the LS wants this message processed without this permission reset, it MUST choose another logical path (if one exists) for this SIP request.

Geolocation-Error: 202 ; code="Permission to Route based on Location Information"

This location error is specific to having the Geolocation-Routing

header value set to "no". This location error is stating it requires permission (i.e., the Geolocation-Routing header value set to "yes") to process this SIP request further. If the LS sending the location information does not want to give this permission, it will not reset this permission in a new request. If the LS wants this message processed without this permission reset, it MUST choose another logical path (if one exists) for this SIP request.

4.5 Location URIs in Message Bodies

In the case where an LR sends a 424 response and wishes to communicate suitable location by reference rather than by value, the 424 MUST include a content-indirection body per RFC 4483.

4.6 Location Profile Negotiation

The following is part of the discussion started in Section 3, Figure 2, which introduced the concept of sending location indirectly.

If a location URI is included in a SIP request, the sending user agent MUST also include a Supported header field indicating which location profiles it supports. Two option tags for location profiles are defined by this document: "geolocation-sip" and "geolocation-http". Future specifications MAY define further location profiles per the IANA policy described in Section 8.3.

The "geolocation-sip" option tag signals support for acquiring location information via the presence event package of SIP ([RFC3856]). A location recipient who supports this option can send a SUBSCRIBE request and parse a resulting NOTIFY containing a PIDF-LO object. The URI schemes supported by this option include "sip", "sips" and "pres".

The "geolocation-http" option tag signals support for acquiring location information via an HTTP ([RFC2616]). A location recipient who supports this option can request location with an HTTP GET and parse a resulting 200 response containing a PIDF-LO object. The URI schemes supported by this option include "http" and "https". A failure to parse the 200 response, for whatever reason, will return a "Dereference Failure" indication to the original location sending user agent to inform it that location was not delivered as intended.

If the location URI receiver does not understand the URI scheme sent to it, it will return an Unsupported header value of the option-tag from the SIP request, and include the option-tag of the preferred URI scheme in the response's Supported header field.

See [ID-GEO-FILTERS] or [ID-HELD-DEREF] for more details on

dereferencing location information.

5. Geolocation Examples

5.1 Location-by-value (in Coordinate Format)

This example shows an INVITE message with a coordinate location. In this example, the SIP request uses a sips-URI [RFC3261], meaning this message is protected using TLS on a hop-by-hop basis.

```
INVITE sips:bob@biloxi.example.com SIP/2.0
Via: SIPS/2.0/TLS pc33.atlanta.example.com;branch=z9hG4bK74bf9
Max-Forwards: 70
To: Bob <sips:bob@biloxi.example.com>
From: Alice <sips:alice@atlanta.example.com>;tag=9fxced76sl
Call-ID: 3848276298220188511@atlanta.example.com
Geolocation: <cid:target123@atlanta.example.com>
Geolocation-Routing: no
Accept: application/sdp, application/pidf+xml
CSeq: 31862 INVITE
Contact: <sips:alice@atlanta.example.com>
Content-Type: multipart/mixed; boundary=boundary1
Content-Length: ...

--boundary1

Content-Type: application/sdp

...SDP goes here

--boundary1

Content-Type: application/pidf+xml
Content-ID: <target123@atlanta.example.com>
<?xml version="1.0" encoding="UTF-8"?>
    <presence
       xmlns="urn:ietf:params:xml:ns:pidf"
       xmlns:gp="urn:ietf:params:xml:ns:pidf:geopriv10"
       xmlns:gbp="urn:ietf:params:xml:ns:pidf:geopriv10:basicPolicy"
       xmlns:cl="urn:ietf:params:xml:ns:pidf:geopriv10:civicAddr"
       xmlns:gml="http://www.opengis.net/gml"
       xmlns:dm="urn:ietf:params:xml:ns:pidf:data-model"
       entity="pres:alice@atlanta.example.com">
     <dm:device id="target123-1">
       <gp:geopriv>
         <gp:location-info>
           <gml:location>
             <gml:Point srsName="urn:ogc:def:crs:EPSG::4326">
               <gml:pos>32.86726 -97.16054</gml:pos>
             </gml:Point>
          </gml:location>
```

```
            </gp:location-info>
            <gp:usage-rules>
              <gbp:retransmission-allowed>false
```

```
            </gbp:retransmission-allowed>
            <gbp:retention-expiry>2010-11-14T20:00:00Z
            </gbp:retention-expiry>
          </gp:usage-rules>
          <gp:method>802.11</gp:method>
        </gp:geopriv>
        <dm:deviceID>mac:1234567890ab</dm:deviceID>
        <dm:timestamp>2010-11-04T20:57:29Z</dm:timestamp>
      </dm:device>
   </presence>
--boundary1--
```

The Geolocation header field from the above INVITE:

```
   Geolocation: <cid:target123@atlanta.example.com>
```

... indicates the content-ID location [RFC2392] within the multipart message body of where location information is. The other message body part is SDP. The "cid:" eases message body parsing and disambiguates multiple parts of the same type.

If the Geolocation header field did not contain a "cid:" scheme, for example, it could look like this location URI:

```
   Geolocation: <sips:target123@server5.atlanta.example.com>
```

... the existence of a non-"cid:" scheme indicates this is a location URI, to be dereferenced to learn the Target's location. Any node wanting to know where the target is located would subscribe to the SIP presence event package [RFC3856] at

```
   sips:target123@server5.atlanta.example.com
```

(see Figure 2 in Section 3.2 for this message flow).

5.2 Two Locations Composed in Same Location Object Example

This example shows the INVITE message after a SIP intermediary rejected the original INVITE (say, the one in section 5.1). This INVITE contains the composed LO sent by the SIP intermediary which includes where the intermediary understands Alice to be. The rules of RFC 5491 [RFC5491] are followed in this construction.

This example is here, but ought not be taken as occurring very often. In fact, this example is believed to be a corner case of location conveyance applicability.

```
INVITE sips:bob@biloxi.example.com SIP/2.0
Via: SIPS/2.0/TLS pc33.atlanta.example.com;branch=z9hG4bK74bf0
```

```
   Max-Forwards: 70
   To: Bob <sips:bob@biloxi.example.com>
```

```
   From: Alice <sips:alice@atlanta.example.com>;tag=9fxced76sl
   Call-ID: 3848276298220188512@atlanta.example.com
   Geolocation: <cid:target123@atlanta.example.com>
   Geolocation-Routing: no
   Accept: application/sdp, application/pidf+xml
   CSeq: 31863 INVITE
   Contact: <sips:alice@atlanta.example.com>
   Content-Type: multipart/mixed; boundary=boundary1
   Content-Length: ...

   --boundary1

   Content-Type: application/sdp

   ...SDP goes here

   --boundary1

   Content-Type: application/pidf+xml
   Content-ID: <target123@atlanta.example.com>
   <?xml version="1.0" encoding="UTF-8"?>
       <presence
          xmlns="urn:ietf:params:xml:ns:pidf"
          xmlns:gp="urn:ietf:params:xml:ns:pidf:geopriv10"
          xmlns:gbp="urn:ietf:params:xml:ns:pidf:geopriv10:basicPolicy"
          xmlns:dm="urn:ietf:params:xml:ns:pidf:data-model"
          xmlns:cl="urn:ietf:params:xml:ns:pidf:geopriv10:civicAddr"
          xmlns:gml="http://www.opengis.net/gml"
          entity="pres:alice@atlanta.example.com">
        <dm:device id="target123-1">
          <gp:geopriv>
            <gp:location-info>
              <gml:location>
                <gml:Point srsName="urn:ogc:def:crs:EPSG::4326">
                  <gml:pos>32.86726 -97.16054</gml:pos>
                </gml:Point>
              </gml:location>
            </gp:location-info>
            <gp:usage-rules>
              <gbp:retransmission-allowed>false
              </gbp:retransmission-allowed>
             <gbp:retention-expiry>2010-11-14T20:00:00Z
              </gbp:retention-expiry>
            </gp:usage-rules>
            <gp:method>802.11</gp:method>
          </gp:geopriv>
          <dm:deviceID>mac:1234567890ab</dm:deviceID>
          <dm:timestamp>2010-11-04T20:57:29Z</dm:timestamp>
        </dm:device>
```

```
        <dm:person id="target123">
          <gp:geopriv>
            <gp:location-info>
```

```
            <cl:civicAddress>
              <cl:country>US</cl:country>
              <cl:A1>Texas</cl:A1>
              <cl:A3>Colleyville</cl:A3>
              <cl:RD>Treemont</cl:RD>
              <cl:STS>Circle</cl:STS>
              <cl:HNO>3913</cl:HNO>
              <cl:FLR>1</cl:FLR>
              <cl:NAM>Haley's Place</cl:NAM>
              <cl:PC>76034</cl:PC>
            </cl:civicAddress>
          </gp:location-info>
          <gp:usage-rules>
            <gbp:retransmission-allowed>false
            </gbp:retransmission-allowed>
            <gbp:retention-expiry>2010-11-14T20:00:00Z
            </gbp:retention-expiry>
          </gp:usage-rules>
          <gp:method>triangulation</gp:method>
        </gp:geopriv>
        <dm:timestamp>2010-11-04T12:28:04Z</dm:timestamp>
      </dm:person>
    </presence>
--boundary1--
```

6. Geopriv Privacy Considerations

Location information is considered by most to be highly sensitive information, requiring protection from eavesdropping and altering in transit. [RFC3693] originally articulated rules to be followed by any protocol wishing to be considered a "Using Protocol", specifying how a transport protocol meets those rules. [ID-GEO-ARCH] updates the guidance in RFC3693 to include subsequently-introduced entities and concepts in the geolocation architecture.

Implementations of this SIP location conveyance mechanism MUST adhere to the guidance given in RFC3693 and its updates and/or successors, including (but not limited to) the handling of rules for retention and retransmission.

7. Security Considerations

Conveyance of physical location of a UA raises privacy concerns, and depending on use, there probably will be authentication and integrity concerns. This document calls for conveyance to be accomplished through secure mechanisms, like S/MIME encrypting message bodies (although this is not widely deployed), TLS

protecting the overall signaling or conveyance location by-reference and requiring all entities that dereference location to authenticate themselves. In location-based routing cases, encrypting the

location payload with an end-to-end mechanism such as S/MIME is problematic, because one or more proxies on the path need the ability to read the location information to retarget the message to the appropriate new destination UAS. Data can only be encrypted to a particular, anticipated target, and thus if multiple recipients need to inspect a piece of data, and those recipients cannot be predicted by the sender of data, encryption is not a very feasible choice. Securing the location hop-by-hop, using TLS, protects the message from eavesdropping and modification in transit, but exposes the information to all proxies on the path as well as the endpoint. In most cases, the UA has no trust relationship with the proxy or proxies providing location-based routing services, so such end-to-middle solutions might not be appropriate either.

When location information is conveyed by reference, however, one can properly authenticate and authorize each entity that wishes to inspect location information. This does not require that the sender of data anticipate who will receive data, and it does permit multiple entities to receive it securely, but it does not however obviate the need for pre-association between the sender of data and any prospective recipients. Obviously, in some contexts this pre-association cannot be presumed; when it is not, effectively unauthenticated access to location information must be permitted. In this case, choosing pseudo-random URIs for location by-reference, coupled with path encryption like SIPS, can help to ensure that only entities on the SIP signaling path learn the URI, and thus restores rough parity with sending location by-value.

Location information is especially sensitive when the identity of its Target is obvious. Note that there is the ability, according to [RFC3693] to have an anonymous identity for the Target's location. This is accomplished by use of an unlinkable pseudonym in the "entity=" attribute of the <presence> element [RFC4479]. Though, this can be problematic for routing messages based on location (covered in the document above). Moreover, anyone fishing for information would correlate the identity at the SIP layer with that of the location information referenced by SIP signaling.

When a UA inserts location, the UA sets the policy on whether to reveal its location along the signaling path - as discussed in Section 4, as well as flags in the PIDF-LO [RFC4119]. UAC implementations MUST make such capabilities conditional on explicit user permission, and MUST alert the user that location is being conveyed.

This SIP extension offers the default ability to require permission to view location while the SIP request is in transit. The default for this is set to "no". There is an error explicitly describing how an intermediary asks for permission to view the Target's

location, plus a rule stating the user has to be made aware of this permission request.

There is no end-to-end integrity on any locationValue or locationErrorValue header field parameter (or middle-to-end if the value was inserted by a intermediary), so recipients of either header field need to implicitly trust the header field contents, and take whatever precautions each entity deems appropriate given this situation.

8. IANA Considerations

The following are the IANA considerations made by this SIP extension. Modifications and additions to all these registrations require a standards track RFC (Standards Action).

[Editor's Note: RFC-Editor - within the IANA section, please replace "this doc" with the assigned RFC number, if this document reaches publication.]

8.1 IANA Registration for the SIP Geolocation Header Field

The SIP Geolocation Header Field is created by this document, with its definition and rules in Section 4.1 of this document, and should be added to the IANA sip-parameters registry with the following actions

1. Update the Header Fields registry with

Registry:

Header Name	compact	Reference
Geolocation		[this doc]

8.2 IANA Registration for the SIP Geolocation-Routing Header Field

The SIP Geolocation-Routing Header Field is created by this document, with its definition and rules in Section 4.2 of this document, and should be added to the IANA sip-parameters registry with the following action

1. Update the Header Fields registry with

Registry:

Header Name	compact	Reference
Geolocation-Routing		[this doc]

8.3 IANA Registration for Location Profiles

This document defines two new SIP option tags: "geolocation-sip" and "geolocation-http" to be added to the IANA sip-parameters Options

Tags registry.

Name	Description	Reference
geolocation-sip	The "geolocation-sip" option tag signals support for acquiring location information via the presence event package of SIP (RFC 3856). A location recipient who supports this option can send a SUBSCRIBE request and parse a resulting NOTIFY containing a PIDF-LO object. The URI schemes supported by this option include "sip", "sips" and "pres".	[this doc]
geolocation-http	The "geolocation-http" option tag signals support for acquiring location information via an HTTP ([RFC2616]). A location recipient who supports this option can request location with an HTTP GET and parse a resulting 200 response containing a PIDF-LO object. The URI schemes supported by this option include "http" and "https".	[this doc]

The names of profiles are SIP option-tags, and the guidance in this document does not supersede the option-tag assignment guidance in [RFC3261] (which requires a Standards Action for the assignment of a new option tag). This document does however stipulate that option-tags included to convey the name of a location profile per this definition MUST begin with the string "geolocation" followed by a dash. All such option tags should describe protocols used to acquire location by reference: these tags have no relevance to location carried in SIP requests by value, which use standard MIME typing and negotiation.

8.4 IANA Registration for 424 Response Code

In the SIP Response Codes registry, the following is added

Reference: RFC-XXXX (i.e., this document)
Response code: 424 (recommended number to assign)
Default reason phrase: Bad Location Information

Registry:

Response Code	Reference
Request Failure 4xx	
424 Bad Location Information	[this doc]

This SIP Response code is defined in section 4.3 of this document.

8.5 IANA Registration of New Geolocation-Error Header Field

The SIP Geolocation-error header field is created by this document, with its definition and rules in Section 4.4 of this document, to be added to the IANA sip-parameters registry with two actions

1. Update the Header Fields registry with

Registry:

Header Name	compact	Reference
Geolocation-Error		[this doc]

2. In the portion titled "Header Field Parameters and Parameter Values", add

Header Field	Parameter Name	Predefined Values	Reference
Geolocation-Error	code	yes	[this doc]

8.6 IANA Registration for the SIP Geolocation-Error Codes

This document creates a new registry for SIP, called "Geolocation-Error Codes." Geolocation-Error codes provide reason for the error discovered by Location Recipients, categorized by action to be taken by error recipient. The initial values for this registry are shown below.

Registry Name: Geolocation-Error Codes
Reference: [this doc]
Registration Procedures: Specification Required

Code	Default Reason Phrase	Reference
100	"Cannot Process Location"	[this doc]
200	"Permission To Use Location Information"	[this doc]
201	"Permission To Retransmit Location Information to a Third Party"	[this doc]
202	"Permission to Route based on Location Information"	[this doc]
300	"Dereference Failure"	[this doc]

Details of these error codes are in Section 4.4 of this document.

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And finally, to Spencer Dawkins for giving this doc a good scrubbing to make it more readable.

10. References

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Appendix A. Requirements for SIP Location Conveyance

The following subsections address the requirements placed on the UAC, the UAS, as well as SIP proxies when conveying location. If a requirement is not obvious in intent, a motivational statement is included below it.

A.1 Requirements for a UAC Conveying Location

UAC-1 The SIP INVITE Method [RFC3261] must support location conveyance.

UAC-2 The SIP MESSAGE method [RFC3428] must support location

conveyance.

UAC-3 SIP Requests within a dialog should support location conveyance.

UAC-4 Other SIP Requests may support location conveyance.

UAC-5 There must be one, mandatory to implement means of transmitting location confidentially.

Motivation: to guarantee interoperability.

UAC-6 It must be possible for a UAC to update location conveyed at any time in a dialog, including during dialog establishment.

Motivation: if a UAC has moved prior to the establishment of a dialog between UAs, the UAC must be able to send location information. If location has been conveyed, and the UA moves, the UAC must be able to update the location previously conveyed to other parties.

UAC-7 The privacy and security rules established within [RFC3693] that would categorize SIP as a 'Using Protocol' must be met.

UAC-8 The PIDF-LO [RFC4119] is a mandatory to implement format for location conveyance within SIP.

Motivation: interoperability with other IETF location protocols and Mechanisms.

UAC-9 There must be a mechanism for the UAC to request the UAS send its location.

UAC-9 has been DEPRECATED by the SIP WG, due to the many problems this requirement would have caused if implemented. The solution is for the above UAS to send a new request to the original UAC with the UAS's location.

UAC-10 There must be a mechanism to differentiate the ability of the UAC to convey location from the UACs lack of knowledge of its location

Motivation: Failure to receive location when it is expected can happen because the UAC does not implement this extension, or because the UAC implements the extension, but does not know where the Target is. This may be, for example, due to the failure of the access network to provide a location acquisition mechanism the UAC supports. These cases must be differentiated.

UAC-11 It must be possible to convey location to proxy servers along the path.

Motivation: Location-based routing.

A.2 Requirements for a UAS Receiving Location

The following are the requirements for location conveyance by a UAS:

UAS-1 SIP Responses must support location conveyance.

The SIPCORE WG reached consensus that this be allowed, but not to communicate the UAS's location; rather for a SIP intermediary to inform the UAC which location to include in its next SIP request (as a matter of correcting what was originally sent by the UAC).

UAS-2 There must be a unique 4XX response informing the UAC it did not provide applicable location information.

In addition, requirements UAC-5, 6, 7 and 8 also apply to the UAS.

A.3 Requirements for SIP Proxies and Intermediaries

The following are the requirements for location conveyance by a SIP proxies and intermediaries:

Proxy-1 Proxy servers must be capable of adding a Location header field during processing of SIP requests.

Motivation: Provide network assertion of location when UACs are unable to do so, or when network assertion is more reliable than UAC assertion of location

Note: Because UACs connected to SIP signaling networks can have widely varying access network arrangements, including VPN tunnels and roaming mechanisms, it can be difficult for a network to reliably know the location of the endpoint. Proxies SHOULD NOT assert location of an endpoint unless the SIP signaling network has reliable knowledge of the actual location of the Targets.

Proxy-2 There must be a unique 4XX response informing the UAC it did not provide applicable location information.