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A Document Format for Filtering and Reporting Location Notications in PIDF-LO
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Status of this Memo

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Abstract

This document describes filters which limit asynchronous location notifications to compelling events. The resulting location information is conveyed in existing location formats wrapped in GEOPRIV privacy extensions to the Presence Information Document Format (PIDF-LO). Location disclosure is limited to voluntary disclosure by a notifier that possesses credentials for the named resource.

Table of Contents

1. Conventions

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 [2].

2. Overview

Conveying static location in PIDF-LO [1] bodies is straightforward. However the difficult part about asynchronous notification of location information is that many forms of location are measured as a continous gradient. Unlike notications using discreet quanties, it is difficult to know when a change in location is large enough to warrant notifications. Moreover, different applications require a wide variety of location resolutions. Any optimization made for one application would ultimately result in wasteful polling or a sluggish user interface for other applications.

The mechanism described here defines filters in XML [3] documents which limit location notification to events which are of relevance to the subscriber. These filters persist until they are changed with a replacement filter.

In addition to the relevant filters, this document also defines a new XML schema [4] which can be included in PIDF-LO documents to indicate that the resource is inside or outside of a container region.

3. Definition of Location Filter Format

The granularity of notifications necessary for various geographic location applications varies dramatically. The subscriber should be able to get asynchronous notifications with appropriate granularity and accuracy, without having to poll or flood the network with notifications which are not important to the application. Notifications should only happen when the notification would be considered an Interesting Event to the subscriber. Subscriptions to

this event package contain a filter document in the XML document format defined in this section. The terminal elements in this format are defined in terms of existing Geographic Markup Language (GML) [8] data types.

The notifications are in PIDF-LO (by default) or any other format acceptable to both the subscriber and notifier. The selection of a subset of GML or specific location format capabilities contained in a PIDF-LO body is a generic issue for the GEOPRIV Working Group to define, and is out of the scope of this document.

This document defines the following as an initial list of Interesting Events:

1. the resource moves more than a specific distance horizontally or vertically since the last notification
2. the resource exceeds a specific speed
3. the resource enters or exits one or more GML objects (for example, a set of 2-dimensional or 3-dimensional regions) included or referenced in the filter.
4. one or more of the values of the specified address labels has changed for the resource (for example, the A1 value of the civilAddress has changed from California to Nevada)

This specification makes use of XML namespaces [5] for identifying location filter documents and document fragments. The namespace URI for elements defined by this specification is a URN [9], using the namespace identifier 'ietf' defined by [10] and extended by [11]. This URN is:

urn:ietf:params:xml:ns:location-filter

The filter format starts with a top-level XML element called "<location-filter>", which contains one or more filter events. The semantics of multiple elements inside a location-filter is a logical OR. In other words, if any of the individual filter events occurs, the event satisfies the location-filter and triggers a notification.

The movedHoriz and movedVert filter events each indicate a minimum horizontal motion or vertical distance (respectively) that the resource must have moved from the location of the resource when the last notification was sent in order to trigger this event. The distance is measured absolutely from the point of last notification rather than in terms of cumulative motion (For example, someone

pacing inside a room will not trigger an event if the trigger threshold is slightly larger than the room.) Each of these events can only appear once in a location-filter. These events have an attribute "uom" (for "units of measure"), which indicates the units of the element. The default unit for these events is meters.

Similarly, the speedExceeds filter event indicates a minimum horizontal speed of the resource before the speedExceeds event is triggered. This element can appear only once in a location-filter, and has a "uom" attribute which defaults to meters per second if not present.

This filter measures the horizontal component of speed in any direction. It does not measure velocity. Note also that there is no corresponding event triggered when speed drops below a threshold.

Below are some examples. In the first example if the resource moves 20m in the x,y direction or 3m in the z direction, send a notification:


```
<location-filter>
  <movedHoriz uom="#meters">20</movedHoriz>
  <movedVert uom="#meters">3</movedVert>
</location-filter>
```

If the resource exceeds 3 meters per second (10.8 km/h), send a notification:

```
<location-filter>
  <speedExceeds uom="#mps">3</speedExceeds>
</location-filter>
```

The valueChanges filter event contains a string which is interpreted as an XPath [6] expression evaluated within the context of the location-info element of the PIDF-LO document which would be generated by the notification. The XPath expression MUST evaluate to only a single Xpath node. If the value of any of the elements in the resulting node changes, then the filter event is triggered. Note that the value of the resulting node changes if any of those nodes or subnodes transitions from having a value to having no value or vice versa. A location-filter may contain multiple valueChanges filters.

For example, given the following logical PIDF-LO document, If the state (A1), county (A2), city (A3), or postal code (PC) changes, send a notification:

PIDF-LO Location Document:

```
<?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:cl="urn:ietf:params:xml:ns:pidf:geopriv10:civilLoc"
   entity="pres:geotarget@example.com">
 <tuple id="sg89ae">
  <status>
   <gp:geopriv>
     <gp:location-info>
       <cl:civilAddress>
         <cl:country>US</cl:country>
         <cl:A1>New York</cl:A1>
         <cl:A3>New York</cl:A3>
         <cl:A6>Broadway</cl:A6>
```

```
              <cl:HNO>123</cl:HNO>
              <cl:LOC>Suite 75</cl:LOC>
              <cl:PC>10027</cl:PC>
            </cl:civilAddress>
          </gp:location-info>
          <gp:usage-rules>
            <gp:retransmission-allowed>yes</gp:retransmission-allowed>
            <gp:retention-expiry>2003-06-23T04:57:29Z
            </gp:retention-expiry>
          </gp:usage-rules>
        </gp:geopriv>
       </status>
       <timestamp>2003-06-22T20:57:29Z</timestamp>
      </tuple>
     </presence>
```

```
Filter Document:
  <location-filter
    xmlns="urn:ietf:params:xml:ns:location-filter"
    xmlns:cl="urn:ietf:params:xml:ns:pidf:geopriv10:civilLoc">
    <valueChanges>cl:civilAddress/cl:A1</valueChanges>
    <valueChanges>cl:civilAddress/cl:A2</valueChanges>
    <valueChanges>cl:civilAddress/cl:A3</valueChanges>
    <valueChanges>cl:civilAddress/cl:PC</valueChanges>
  </location-filter>
```

Finally, the "enterOrExit" filter event is triggered when the resource enters or exits a named 2-dimensional or 3-dimensional region or list of regions corresponding to a GML feature. These regions can be defined using inline snippets of GML, or externally referenced using a URI (Uniform Resource Identifier). Notifiers which support this document MUST be able to support 2-dimensional regions and lists of regions, for which the regions can be defined in

terms of the GML extentOf a Polygon defined using an exterior LinearRing object. These Polygons are defined using the hierarcy in the figure below.

```
Hierarchy for 2-D          Hierarchy for 3-D
Objects                    Objects

    extentOf                Solid
```

```
Polygon                    exterior
  exterior                   Surface
    LinearRing                 patches
      posList                    Polygon
                                 ...
                                 Polygon
```

Similarly, Notifiers MUST be able to support 3-dimensional regions which can be defined as a fixed height vertical projection of such a 2-dimensional Polygon, and lists thereof. Specifically, these are GML Solids defined in terms of an exterior Surface of polygonal patches, such that all included Polygons are either parallel (horizontal) or perpedicular (vertical) to the geoid.

The posList for any 2-dimensional region MUST be defined using the EPSG 4326 coordinate reference system. The posList for any 3-dimensional region MUST be defined using the EPSG 4979 coordinate reference system. A location-filter can contain more than one enterOrExit filter event.

Notifiers MAY support other more complex geometries or additional coordinate reference systems. How the Subscriber negotiates support for more complex geometries or reference systems is out of the scope of this document.

Likewise, this document does not describe how a subscriber discovers the existence of externally referenced features. This topic is out of scope of this document.

In most cases Subscribers that use location filters based on enterOrExit events are especially interested in the resource's relationship to those named features. Consequently, the notifier MUST include either a "containment" element for each feature mentioned in the location-filter which has changed its containment properties with respect to the resource since the last notification. These elements are defined in Section 4. The notifier MAY include any other form of location that is relevant.

For example, if the resource enters or exits Building 10 (which is defined by specific 2-D or 3-D rectangular coordinates), send a notification:

Version in 2-Dimensions:

```
<location-filter>
  <enterOrExit>
    <my:Building>
      <gml:name>Building 10</gml:name>
      <gml:extentOf>
        <gml:Polygon>
          <gml:exterior>
            <gml:LinearRing>
              <gml:posList
     srsName="http://www.opengis.net/gml/srs/epsg.xml/#4979">
                    37.41188 -121.93243 0
                    37.41188 -121.93132 0
                    37.41142 -121.93132 0
                    37.41142 -121.93242 0
                    37.41188 -121.93243 0
              </gml:posLis>
            </gml:LinearRing>
          </gml:exterior>
        </gml:Polygon>
      </gml:extentOf>
    </my:Building>
  </enterOrExit>
</location-filter>

Version in 3-Dimensions:
<location-filter>
  <enterOrExit>
    <my:Building>
      <gml:name>Building 10</gml:name>
      <gml:Solid>
        <gml:exterior>
          <gml:Surface>
            <gml:patches>
              <gml:Polygon> <!-- floor -->
                <gml:exterior>
                  <gml:LinearRing>
                    <gml:posList
     srsName="http://www.opengis.net/gml/srs/epsg.xml/#4979">
                         37.41188 -121.93243 0
                         37.41188 -121.93132 0
                         37.41142 -121.93132 0
                         37.41142 -121.93242 0
                         37.41188 -121.93243 0
                    </gml:posLis>
                  </gml:LinearRing>
                </gml:exterior>
              </gml:Polygon>
```

```
            <gml:Polygon> <!-- north wall -->
              <gml:exterior>
                <gml:LinearRing>
                  <gml:posList
      srsName="http://www.opengis.net/gml/srs/epsg.xml/#4979">
                      37.41188 -121.93243 0
                      37.41188 -121.93243 0
                      37.41188 -121.93132 25
                      37.41188 -121.93132 25
                      37.41188 -121.93243 0
                  </gml:posLis>
                </gml:LinearRing>
              </gml:exterior>
            </gml:Polygon>
            <gml:Polygon> <!-- east wall -->
              <gml:exterior>
                <gml:LinearRing>
                  <gml:posList
      srsName="http://www.opengis.net/gml/srs/epsg.xml/#4979">
                      37.41188 -121.93132 0
                      37.41188 -121.93132 25
                      37.41142 -121.93132 25
                      37.41142 -121.93132 0
                      37.41188 -121.93132 0
                  </gml:posLis>
                </gml:LinearRing>
              </gml:exterior>
            </gml:Polygon>
            <gml:Polygon> <!-- south wall -->
              <gml:exterior>
                <gml:LinearRing>
                  <gml:posList
      srsName="http://www.opengis.net/gml/srs/epsg.xml/#4979">
                      37.41142 -121.93132 0
                      37.41142 -121.93132 25
                      37.41142 -121.93242 25
                      37.41142 -121.93242 0
                      37.41142 -121.93132 0
                  </gml:posLis>
                </gml:LinearRing>
              </gml:exterior>
            </gml:Polygon>
            <gml:Polygon> <!-- west wall -->
              <gml:exterior>
                <gml:LinearRing>
                  <gml:posList
```

```
        srsName="http://www.opengis.net/gml/srs/epsg.xml/#4979">
                            37.41142 -121.93243 0
```



```
                            37.41142 -121.93243 25
                            37.41188 -121.93243 25
                            37.41188 -121.93243 0
                            37.41142 -121.93243 0
                          </gml:posLis>
                        </gml:LinearRing>
                      </gml:exterior>
                    </gml:Polygon>
                    <gml:Polygon> <!-- roof -->
                      <gml:exterior>
                        <gml:LinearRing>
                          <gml:posList
        srsName="http://www.opengis.net/gml/srs/epsg.xml/#4979">
                            37.41188 -121.93243 25
                            37.41188 -121.93132 25
                            37.41142 -121.93132 25
                            37.41142 -121.93242 25
                            37.41188 -121.93243 25
                          </gml:posLis>
                        </gml:LinearRing>
                      </gml:exterior>
                    </gml:Polygon>
                  </gml:patches>
                </gml:Surface>
              </gml:exterior>
            </gml:Solid>
          </my:Building>
        </enterOrExit>
      </location-filter>
```

If the resource enters or exits either the parking garage or any of the conference rooms (both of which are externally defined), send a notification:

```
<location-filter>
  <enterOrExit>
    <my:ParkingGarage
xlink:href="http://server.example.com/loc-defs/bldg-mgr/parking"/>
  </enterOrExit>
```

```
    <enterOrExit>
      <my:ConferenceRooms
  xlink:href="http://server.example.com/loc-defs/userdef/confrooms"/>
    </enterOrExit>
  </location-filter>
```


3.1 XML Schema for filter format

The XML Schema for this format is defined below.

```
<?xml version="1.0" encoding="UTF-8"?>
<xs:schema
  targetNamespace="urn:ietf:params:xml:ns:location-filter"
  xmlns:xs="http://www.w3.org/2001/XMLSchema"
  xmlns:gml="http://www.opengis.net/gml">

  <xs:element name="location-filter">
    <xs:complexType>
      <xs:sequence>
        <xs:element name="movedHoriz" type="gml:MeasureType"
                    minOccurs="0" maxOccurs="1"/>
        <xs:element name="movedVert" type="gml:MeasureType"
                    minOccurs="0" maxOccurs="1"/>
        <xs:element name="speedExceeds" type="gml:MeasureType"
                    minOccurs="0" maxOccurs="1"/>

        <!-- this type needs to hold an XPath statement -->
        <xs:element name="valueChanges" type="xs:string"
                    minOccurs="0" maxOccurs="unbounded"/>

        <xs:element name="enterOrExit" type="gml:FeaturePropertyType"
                    minOccurs="0" maxOccurs="unbounded"/>

        <!-- Do we want to incldue this to allow new filters? -->
        <xs:any namespace="##other" processContents="lax"
           minOccurs="0"  maxOccurs="unbounded"/>
      </xs:sequence>
    </xs:complexType>
```

```
  </xs:element>
</xs:schema>
```

4. Containment schema

This section describes the schema for describing the resource's location relative to a region or list of regions which might contain the resource. (These regions can be defined dynamically in an "enterOrExit" element in a subscription filter, or defined on the notifier using some out-of-band mechanism.) The "pidfResource" element is placed inside the location-info element in a PIDF-LO document. The pidfResource element can contain zero or more

"containment" elements. Each containment element has a GML Feature sub-element (of type "FeaturePropertyType") and a mandatory attribute which specifies if the PIDF resource is inside or outside of the feature, or if the position of the resource with respect to the region or region list is undefined. If the subscriber is not authorized to know the relative position, the notifier MUST NOT reveal this private information. The RECOMMENDED way to prevent the subscriber from seeing private location data of this type is to return a containment element whose position attribute is "undefined".

```
<?xml version="1.0" encoding="UTF-8"?>
<xs:schema
targetNamespace="urn:ietf:params:xml:ns:pidf:geopriv10:containment"
    xmlns:xs="http://www.w3.org/2001/XMLSchema"
    xmlns:gml="http://www.opengis.net/gml"
xmlns:pr="urn:ietf:params:xml:ns:pidf:geopriv10:containment" >
  <xs:element name="pidfResource">
    <xs:complexType>
        <xs:sequence>
            <xs:element ref="pr:containment"
             minOccurs="0" maxOccurs="unbounded"/>
        </xs:sequence>
    </xs:complexType>
  </xs:element>
```

```
  <xs:element name="containment">
    <xs:complexType>
        <xs:sequence>
          <xs:any namespace="http://www.opengis.net/gml"
                minOccurs="1" maxOccurs="1"/>
        </xs:sequence>
       <xs:attribute name="position" use="required">
          <xs:simpleType>
        <xs:restriction base="xs:string">
            <xs:enumeration value="inside"></xs:enumeration>
            <xs:enumeration value="outside"></xs:enumeration>
            <xs:enumeration value="undefined"></xs:enumeration>
          </xs:restriction>
        </xs:simpleType>
      </xs:attribute>
    </xs:complexType>
  </xs:element>
</xs:schema>
```

Below is an example PIDF-LO document which indicates that the resource is inside building 10, not outside the parking garage, and not permitted to know if the resource is in a conference room. Note that in GML, these features could be referenced by their unique

identifiers instead.

```
<?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:pr="urn:ietf:params:xml:ns:pidf:geopriv10:containment"
     entity="pres:geotarget@example.com">
   <tuple id="sg89ae">
    <status>
     <gp:geopriv>
       <gp:location-info>
         <pr:pidfResource>
           <pr:containment position="inside">
            <my:Building>
               <gml:name>Building 10</gml:name>
             </my:Building>
           </pr:containment>
           <pr:containment position="outside">
```

```
              <my:ParkingGarage
   xlink:href="http://server.example.com/loc-defs/bldg-mgr/parking"/>
            </pr:containment>
            <pr:containment position="undefined">
              <my:ConferenceRooms
   xlink:href="http://server.example.com/loc-defs/userdef/confrooms"/>
            </pr:containment>
          </pr:pidfResource>
        </gp:location-info>
        <gp:usage-rules>
          <gp:retransmission-allowed>yes</gp:retransmission-allowed>
          <gp:retention-expiry>2003-06-23T04:57:29Z
          </gp:retention-expiry>
         </gp:usage-rules>
      </gp:geopriv>
     </status>
     <timestamp>2003-06-22T20:57:29Z</timestamp>
    </tuple>
  </presence>
```

5. Security Considerations

Location information is typically very privacy sensitive. As such, GEOPRIV requires that notifications MUST be encrypted and integrity protected.

Additional privacy and security considerations are discussed in detail in [7].

6. IANA Considerations

6.1 MIME Registration for application/location-delta-filter+xml

MIME media type name: application

MIME subtype name: application/location-delta-filter+xml

Required parameters: none.

Optional parameters: none.

Encoding considerations: Same as for XML.

Security considerations: See the "Security Considerations" section in this document.

Interoperability considerations: none

Published specification: This document.

Applications which use this media: The application/ location-delta-filter+xml application subtype supports the exchange of filters to throttle asynchronous notifications of location information.

Additional information:

1. Magic number(s): N/A

2. File extension(s): N/A

3. Macintosh file type code: N/A

6.2 URN Sub-Namespace Registration for urn:ietf:params:xml:ns:location-filter

This section registers a new XML namespace, as per the guidelines in [11].
URI: The URI for this namespace is
urn:ietf:params:xml:ns:location-filter.
Registrant Contact: IETF, GEOPRIV working group, <geopriv@ietf.org>, as delegated by the IESG <iesg@ietf.org>.

XML:

BEGIN

```
<?xml version="1.0"?>
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML Basic 1.0//EN"
          "http://www.w3.org/TR/xhtml-basic/xhtml-basic10.dtd">
<html xmlns="http://www.w3.org/1999/xhtml">
<head>
  <meta http-equiv="content-type"
     content="text/html;charset=iso-8859-1"/>
  <title>Location Filter Namespace</title>
</head>
<body>
  <h1>Namespace for PIDF-LO Location Filters</h1>
  <h2>urn:ietf:params:xml:ns:location-filter</h2>
  <p>See <a href="[[[URL of published RFC]]]">RFCXXXX</a>.</p>
</body>
</html>
END
```

6.3 Schema Registration For location-filter

This specification registers a schema, as per the guidelines in in [11].

URI: please assign.

Registrant Contact: IETF, GEOPRIV Working Group (geopriv@ietf.org), as delegated by the IESG (iesg@ietf.org).

XML: The XML can be found as the sole content of Section 3.1.

6.4 URN Sub-Namespace Registration for urn:ietf:params:xml:ns:pidf:geopriv10:containment

This section registers a new XML namespace, as per the guidelines in [11].

URI: The URI for this namespace is urn:ietf:params:xml:ns:pidf:geopriv10:containment.

Registrant Contact: IETF, GEOPRIV working group, <geopriv@ietf.org>, as delegated by the IESG <iesg@ietf.org>.

XML:

```
BEGIN
<?xml version="1.0"?>
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML Basic 1.0//EN"
          "http://www.w3.org/TR/xhtml-basic/xhtml-basic10.dtd">
<html xmlns="http://www.w3.org/1999/xhtml">
<head>
  <meta http-equiv="content-type"
     content="text/html;charset=iso-8859-1"/>
  <title>PIDF-LO Location Containment Namespace</title>
</head>
<body>
  <h1>Namespace for PIDF-LO location containment elements</h1>
  <h2>urn:ietf:params:xml:ns:pidf:geopriv10:containment</h2>
  <p>See <a href="[[[URL of published RFC]]]">RFCXXXX</a>.</p>
</body>
</html>
END
```

6.5 Schema Registration For containment

This specification registers a schema, as per the guidelines in in [11].

URI: please assign.
Registrant Contact: IETF, GEOPRIV Working Group (geopriv@ietf.org), as delegated by the IESG (iesg@ietf.orgw).
XML: The XML can be found as the sole content of Section 4.

7. Acknowledgments

Thanks to Allan Thompson, James Winterbottom, and Martin Thomson for their comments.

8. References

8.1 Normative References

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[4] Thompson, H., Beech, D., Maloney, M., and N. Mendelsohn, "XML Schema Part 1: Structures", W3C REC-xmlschema-1, May 2001, <http://www.w3.org/TR/xmlschema-1/>.

[5] Bray, T., Hollander, D., and A. Layman, "Namespaces in XML", W3C REC-xml-names, January 1999, <http://www.w3.org/TR/REC-xml-names>.

[6] Clark, J. and S. DeRose, "XML Path Language (XPath) Version 1.0", W3C Recommendation xpath, November 1999, <http://www.w3.org/TR/xpath>.

[7] Winterbottom, J., "GEOPRIV PIDF-LO Usage Clarification, Considerations and Recommendations", draft-winterbottom-geopriv-pdif-lo-profile-00 (work in progress), February 2005.

[8] OpenGIS, "Open Geography Markup Language (GML) Implementation Specification", OpenGIS OGC 02-023r4, January 2003, <http://www.opengis.org/techno/implementation.htm>.

8.2 Informational References

[9] Moats, R., "URN Syntax", RFC 2141, May 1997.

[10] Moats, R., "A URN Namespace for IETF Documents", RFC 2648, August 1999.

[11] Mealling, M., "The IETF XML Registry", BCP 81, RFC 3688, January 2004.

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