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Dynamic Extensions to the Presence Information Data Format Location Object (PIDF-LO)

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Abstract

The Geopriv Location Object introduced by the Presence Information Data Format - Location Object (PIDF-LO), RFC 4119, defines a basic XML format for carrying geographical information of a presentity. This document defines PIDF-LO extensions to convey information about moving objects. Elements are defined that enable expression of spatial orientation, speed, heading, and acceleration of the presentity.

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1. Introduction

The Presence Information Data Format - Location Object (PIDF-LO) (see RFC 4119 [RFC4119]) provides geographical location of a presentity. This corresponds to a physical location at a given instance of time. With the extensions defined in [RFC5491] more guidelines to implementers are being provided with respect to the expression location information in PIDF-LO.

The addition of rate of change information to the PIDF-LO enables a range of use cases. These use cases either directly use dynamic information, or use that information for smoother tracking of a position over time. For example, an application that continuously tracks a presentity could use velocity information to extrapolate positions in between times location information is measured. A shipping company could directly use speed to monitor delivery truck speed to ensure speed limits are observed.

2. Terminology

In this document, the key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" are to be interpreted as described in RFC 2119 [RFC2119].

This document uses the term "presentity", as defined in in RFC 2778 [RFC2778], through the document to refer to the device subject to location determination. The similarity with presence concepts and the abstract location privacy architecture, as described in RFC 4079 [RFC4079]), lead to re-use of the Presence Information Data Format (PIDF), see RFC 3863 [RFC3863], and its enhancement for location information with RFC 4119 [RFC4119]. Note that this document does not differentiate between human and non-human objects and hence both are in scope.

3. Dynamic Elements

This document defines a new element, <Dynamic>, for the conveyance of dynamic information.

Dynamic information MAY be included without any other location information being present. When dynamic information is associated with information about the instantaneous position of the presentity, the <Dynamic> element MUST be included in the same <location-info> element as the corresponding geodetic (or civic) location information.

Dynamic information can be safely ignored by a recipient that does not support this specification.

The <Dynamic> element contains the following components:

orientation:

The <orientation> element describes the spatial orientation of the presentity; the direction that the object is pointing. For a device, this orientation might depend on the type of device. See Section 3.1 for details.

speed:

Speed is the time rate of change in position of a presentity without regard for direction; the scalar component of velocity. The value for the <speed> element is a measure that is defined in meters per second.

heading:

Heading is directional component of velocity. See Section 3.1 for details.

acceleration:

Acceleration is the time rate of change of velocity. This element contains the scalar component of velocity, measured in meters per second per second.

Each element can be omitted if no information is available. In the following example the presentity is approximately oriented to the North at a slightly elevated angle. The presentity is travelling 24 meters per second to the West:

```
<?xml version="1.0" encoding="UTF-8"?>
<presence
    xmlns="urn:ietf:params:xml:ns:pidf"
    xmlns:dm="urn:ietf:params:xml:ns:pidf:data-model"
    xmlns:gp="urn:ietf:params:xml:ns:pidf:geopriv10"
    xmlns:dyn="urn:ietf:params:xml:ns:pidf:dynamic"
    xmlns:gml="http://www.opengis.net/gml"
    entity="pres:alice@example.com">
    <dm:device id="abc123">
        <gp:geopriv>
            <gp:location-info>
                <dyn:Dynamic>
                    <dyn:orientation>-3 12</dyn:orientation>
                    <dyn:speed>24</dyn:speed>
                    <dyn:heading>278</dyn:heading>
                </dyn:Dynamic>
            </gp:location-info>
```

```
            <gp:usage-rules/>
            <method>gps</method>
        </gp:geopriv>
        <timestamp>2009-06-22T20:57:29Z</timestamp>
        <dm:deviceID>mac:1234567890ab</dm:deviceID>
    </dm:device>
</presence>
```


Another example shows a PIDF-LO document of the presentity alice@example.com on a bike traveling 12 meters per second and with an acceleration of 2 meters per second. Her position is indicated as a circle. The values for speed and acceleration might be used by a receiver to adjust the uncertainty over time.

```
<?xml version="1.0" encoding="UTF-8"?>
<presence
    xmlns="urn:ietf:params:xml:ns:pidf"
    xmlns:dm="urn:ietf:params:xml:ns:pidf:data-model"
    xmlns:gp="urn:ietf:params:xml:ns:pidf:geopriv10"
    xmlns:dyn="urn:ietf:params:xml:ns:pidf:dynamic"
    xmlns:gml="http://www.opengis.net/gml"
    xmlns:gs="http://www.opengis.net/pidflo/1.0"
    entity="pres:alice@example.com">
```

```
        <dm:device id="abc123">
            <gp:geopriv>
                <gp:location-info>
                    <gs:Circle srsName="urn:ogc:def:crs:EPSG::4326">
                        <gml:pos>42.5463 -73.2512</gml:pos>
                        <gs:radius uom="urn:ogc:def:uom:EPSG::9001">
                            100
                        </gs:radius>
                    </gs:Circle>
                    <dyn:Dynamic>
                        <dyn:speed>12</dyn:speed>
                        <dyn:acceleration>2</dyn:acceleration>
                    </dyn:Dynamic>
                </gp:location-info>
                <gp:usage-rules/>
                <method>gps</method>
            </gp:geopriv>
            <timestamp>2009-06-22T20:57:29Z</timestamp>
            <dm:deviceID>mac:1234567890ab</dm:deviceID>
        </dm:device>
    </presence>
```

3.1. Angular Measures and Coordinate Reference Systems

[RFC5491] constrains the coordinate reference system (CRS) used in PIDF-LO to World Geodetic System 1984 (WGS 84) using either the two-dimensional (latitude, longitude) CRS identified by "urn:ogc:def:crs:EPSG::4326" or the three-dimensional (latitude, longitude, altitude) CRS identified by "urn:ogc:def:crs:EPSG::4979". Dynamic locations similarly assume that either of these coordinate reference systems are used.

The <orientation> and <heading> elements both describe a direction.

The <orientation> element describes the "direction of facing"; the <heading> element describes the "direction of travel". Both measures contain one or two angular values that are expressed relative to the current position of the presentity (see Appendix A). Angular measures are expressed in degrees and values can be negative. If two measures are present, the values MUST be separated by whitespace.

The first measure specifies the horizontal direction from the current

position of the presentity to a point that it is pointing towards (for <orientation>) or travelling towards (for <heading>). Horizontal angles are measured from Northing to Easting. Horizontal angles start from zero when pointing to or travelling towards the North and increase towards the East.

The second measure, if present, specifies the vertical component of this angle. This angle is the elevation from the local horizontal plane. If the second angle value is omitted, the vertical component is unknown. If only one angle is present, <orientation> describes only the horizontal component. For <heading>, the associated <speed> measure contains only the horizontal component of speed.

4. Dynamic Feature XML Schema

```
<?xml version="1.0"?>
<xs:schema
    targetNamespace="urn:ietf:params:xml:ns:pidf:dynamic"
    xmlns:dyn="urn:ietf:params:xml:ns:pidf:dynamic"
    xmlns:xs="http://www.w3.org/2001/XMLSchema"
    elementFormDefault="qualified"
    attributeFormDefault="unqualified">

  <xs:element name="Dynamic" type="dyn:dynamicType"/>

  <xs:complexType name="dynamicType">
    <xs:complexContent>
      <xs:restriction base="xs:anyType">
        <xs:sequence>
          <xs:element name="orientation" minOccurs="0"
                      type="dyn:directionType"/>
          <xs:element name="speed" minOccurs="0"
                      type="xs:double"/>
          <xs:element name="heading" minOccurs="0"
                      type="dyn:directionType"/>
          <xs:element name="acceleration" minOccurs="0"
                      type="xs:double"/>
          <xs:any namespace="##other" processContents="lax"
                  minOccurs="0" maxOccurs="unbounded"/>
        </xs:sequence>
        <xs:anyAttribute namespace="##other" processContents="lax"/>
      </xs:restriction>
    </xs:complexContent>
  </xs:complexType>

  <xs:simpleType name="directionType">
    <xs:restriction base="dyn:doubleListType">
      <xs:minLength value="1"/>
      <xs:maxLength value="2"/>
    </xs:restriction>
  </xs:simpleType>

  <xs:simpleType name="doubleListType">
    <xs:list itemType="xs:double"/>
  </xs:simpleType>

</xs:schema>
```

5. Security Considerations

This document defines additional location elements carried by PIDF-LO. These additional elements provide greater reason to observe the privacy and security considerations described in RFC 4119 [RFC4119].

RFC 4119 points back to RFC 3694 [RFC3694] and RFC 3693 [RFC3693] to describe the threat model and the security requirements imposed on the GEOPRIV architecture for sharing location information as result of the threat model. It is important to note that these two documents often refer to threats related to the current location information of a presentity, while this document introduces dynamic information that may be used by attackers to anticipate the future location of a presentity. While already a series of location snapshots is likely to offer information for guessing the future location of a presentity it has to be said that including more information in a PIDF-LO does increase the severity of an information leak. Those who deploy location based services are in general strongly advised to provide their users with ways to control the distribution of location information to those who have been authorized to see it.

6. IANA Considerations

This section registers a new XML namespace (as described in [RFC3688]) and a new XML schema.

6.1. Dynamic Feature Extensions Namespace Registration

URI: urn:ietf:params:xml:ns:pidf:dynamic"

Registrant Contact: IETF Geopriv Working Group, Hannes Tschofenig (hannes.tschofenig@gmx.net).

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>
  <title>Dynamic Feature Extensions Namespace</title>
</head>
<body>
  <h1>Namespace for Dynamic Feature Extensions to PIDF-LO</h1>
  <h2>urn:ietf:params:xml:ns:pidf:dynamic</h2>
<p>See <a href="[URL of published RFC]">RFCXXXX
    [NOTE TO IANA/RFC-EDITOR:
     Please replace XXXX with the RFC number of this
    specification.]</a>.</p>
</body>
</html>
END
```

6.2. Dynamic Feature Extensions Schema Registration

URI: urn:ietf:params:xml:schema:pidf:dynamic

Registrant Contact: IETF Geopriv Working Group, Hannes Tschofenig (hannes.tschofenig@gmx.net)

XML: The XML schema to be registered is contained in Section 4. Its first line is

```
<?xml version="1.0"?>
```

and its last line is

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

7. Acknowledgements

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8. References

8.1. Normative References

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997.

[RFC3688] Mealling, M., "The IETF XML Registry", BCP 81, RFC 3688, January 2004.

[RFC4119] Peterson, J., "A Presence-based GEOPRIV Location Object Format", RFC 4119, December 2005.

8.2. Informative References

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[RFC3693] Cuellar, J., Morris, J., Mulligan, D., Peterson, J., and J. Polk, "Geopriv Requirements", RFC 3693, February 2004.

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[RFC3863] Sugano, H., Fujimoto, S., Klyne, G., Bateman, A., Carr, W., and J. Peterson, "Presence Information Data Format (PIDF)", RFC 3863, August 2004.

[RFC4079] Peterson, J., "A Presence Architecture for the Distribution of GEOPRIV Location Objects", RFC 4079, July 2005.

[RFC5491] Winterbottom, J., Thomson, M., and H. Tschofenig, "GEOPRIV Presence Information Data Format Location Object (PIDF-LO) Usage Clarification, Considerations, and Recommendations", RFC 5491, March 2009.

Appendix A. Earth Centered, Earth Fixed Direction Vectors

The absolute orientation or heading of a presentity depends on its latitude and longitude. The following vectors can be used to determine the absolute direction in the WGS 84 Earth Centered, Earth

Fixed (X, Y, Z) coordinate space.

The direction of North as a unit vector in ECEF coordinates is:

```
North = [ -1 * sin(latitude) * cos(longitude),
          -1 *  sin(latitude) * sin(longitude),
          cos(latitude) ]
```

The direction of "up" (the upward normal of the horizontal plane) as a unit vector in ECEF coordinates is:

```
Up = [ cos(latitude) * cos(longitude),
       cos(latitude) * sin(longitude),
       sin(latitude) ]
```

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