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Specifying Location Quality Constraints in Location Protocols
draft-thomson-geopriv-location-quality-01

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Internet-Draft

Location Quality

May 2008

Abstract

Parameters that define the expected quality of location information are defined for use in location protocols. These parameter can be used by a requester to indicate to a Location Server the desired constraints on the quality of the location information provided. If applicable, the Location Server is able to use this information to control how location information is determined. An optional indication of whether the quality constraints were met is defined to be provided by the Location Server alongside location information.

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Location Quality

May 2008

1. Introduction

Location determination methods produce results of varying accuracy. In general, the accuracy of location information increases as the effort expended in generating the information increases. Accuracy is the primary aspect of the quality of location information that is relevant to a Location Recipient (LR), but other aspects of quality can also be significant, such as the currency of the data.

This document provides XML extension objects that can be added to any protocol that provides location information. These elements provide the ability to communicate location quality constraints to the location server.

This document provides semantics, examples and security considerations for the HELD protocol [[I-D.ietf-geopriv-http-location-delivery](#)]. Application of the parameters described in this document to other protocols is out of scope.

Means for expressing the quality of location information is outlined in [[I-D.thomson-geopriv-uncertainty](#)] and [[GeoShape](#)]. An entity requesting location information of a Location Server (LS) is unable to specify the quality of the location that it ultimately receives. This is inefficient because an LS either provides location information that is inadequate for the intended task; or the LS could waste resources generating location information that is of excessively high quality.

This document describes an optional HELD parameter that communicates location quality constraints to an LS. These constraints specify a desired uncertainty at a certain confidence, plus the maximum acceptable age where location information is stored. Guidelines for deterministically evaluating location information against these rules are provided.

Some of the benefits of providing an LS with location quality constraints are described in [[I-D.busin-geopriv-location-qos-req](#)]. Location quality constraints provide information that an LS can use in deciding how to generate location information, if the LS uses a Location Generator as a source of location information. This is the case for a Location Information Server (LIS) and the HELD protocol. For example, a LIS that is able to provide a location estimate with a sufficiently small uncertainty might be able to provide a response before the time indicated within the time indicated in the request (the "responseTime").

This document also provides a means by which the LS is able to

indicate if the location quality meets the constraints. These parameters can be used by a Location Recipient to ensure that the location is of adequate quality without requiring specific checking (although the PIDF-LO should include sufficient information to perform this check). Response parameters are optional; the presence of a quality indication in the response also indicates that the LS has understood the location quality constraints.

This document provides solutions that address a subset of the requirements in [[I-D.busin-geopriv-location-qos-req](#)].

1.1. Conventions used in this document

Terms and procedures relating to uncertainty and confidence are taken from [[I-D.thomson-geopriv-uncertainty](#)]. Familiarity with terminology outlined in [[I-D.ietf-geopriv-l7-lcp-ps](#)] and [[RFC3693](#)] is also assumed.

The term Location Server (LS) is used as a generic label, since these parameters apply in all cases where location information is served to a requesting entity. From the perspective of this document, the LS could be a Location Information Server (LIS). Similarly, the term Location Recipient (LR) is used to refer to the requester of location information, which could be a Device or Target for HELD.

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](#)].

[2.](#) Location Quality Operation

Location quality parameters are provided by a Device or any other client of an LS in a location request message. Figure 1 shows an example message.

```
<locationRequest xmlns="urn:ietf:params:xml:ns:geopriv:held">
  <locationType exact="true">geodetic</locationType>
  <quality xmlns="urn:ietf:params:xml:ns:geopriv:lq">
    <maxUncertainty confidence="95">
      <horizontal>150</horizontal>
      <vertical>1000</vertical>
    </maxUncertainty>
    <maxAge>2008-05-27T05:47:55Z</maxAge>
  </quality>
</locationRequest>
```

Figure 1: Example HELD Location Request

A LS that supports the location quality element uses the information contained in the request to choose how it serves the query. The response to this message contains a quality indicator element that

includes a list of the quality constraints that were met. Figure 2 shows a location response that includes a quality indicator.

```
<locationResponse xmlns="urn:ietf:params:xml:ns:geopriv:held">
  <presence xmlns="urn:ietf:params:xml:ns:pidf"
    entity="pres:user@example.com">
    <!-- Actual location information omitted -->
  </presence>
  <qualityInd xmlns="urn:ietf:params:xml:ns:geopriv:lq">
    maxUncertainty/vertical maxAge
  </qualityInd>
</locationResponse>
```

Figure 2: Example HELD Location Response

A LS doesn't indicate the quality of the location estimate in the quality indicator; quality information is included in the PIDF-L0. The quality indicator provides notice to its recipient that the requested quality was provided.

[3. Location Quality Objects](#)

This section defines the format and semantics of the location quality parameters for requests and the indication that is included with responses.

[3.1. Location Quality Request](#)

The "quality" element is included in a HELD request to indicate the constraints set by the Location Recipient (LR) on the quality of returned location information. This document defines three elements that are included.

[3.1.1. Maximum Uncertainty](#)

The "maxUncertainty" element describes an upper limit on uncertainty at a given confidence. Uncertainty is divided in to horizontal and vertical components. Horizontal uncertainty is the maximum distance from the centroid of the area to the point in the shape furthest from the centroid on the horizontal plane. Vertical uncertainty is the difference in altitude from the centroid to the point in the shape with the greatest altitude.

Note: An LS MAY provide location information using the Point shape and indicate that the requested uncertainty is met providing that the LS has access to uncertainty information. However, this is NOT RECOMMENDED since the LR has no way of verifying that the uncertainty meets their requirements.

The "horizontal" and "vertical" elements are numerical values that contain a decimal value in meters. Maximum uncertainty values MUST be greater than zero.

A location estimate that does not contain uncertainty (i.e. a Point shape), never meets location quality constraints. Where uncertainty is unknown, it MUST be assumed to be infinite at any non-zero confidence. In particular, this applies to vertical uncertainty where the location estimate is two-dimensional only; location estimates without a vertical component of uncertainty never meet vertical uncertainty constraints.

The "confidence" attribute of this element includes the confidence level (expressed as a percentage) that the uncertainty is evaluated at. Confidence is set to a default of 95%.

To evaluate uncertainty, the location estimate is first scaled so that the confidence of the estimate matches (or exceeds) the requested confidence. The LS MAY convert the shape of the

uncertainty to a circle or a sphere prior to scaling to simply the scaling process. For consistency -- and contrary to the rules in [\[I-D.thomson-geopriv-uncertainty\]](#) -- it is RECOMMENDED that a normal PDF be used for all location information except where confidence is reduced for a rectangular PDF.

Horizontal uncertainty is evaluated by removing the altitude and altitude uncertainty components from the location estimate. While

removing altitude components from a location estimate might normally increase confidence, confidence MUST NOT be increased at this step; the confidence value has already been considered. The shape is then converted to a circle, if it is not already in that shape. The radius of the resulting circle is compared to the maximum horizontal uncertainty.

Vertical uncertainty is evaluated for shapes that contain altitude uncertainty. The value used for evaluating vertical uncertainty depends on the shape type: the vertical axis value for the Ellipsoid shape; the radius of the Sphere shape; half the height of the Prism shape.

The LS MAY use location quality parameters to alter the way that it generates location information and to provide location information that more closely matches what is requested. If maximum value is provided for vertical uncertainty, it is RECOMMENDED that the LS provide a location estimate that includes altitude and altitude uncertainty. It is RECOMMENDED that the LS provide location information at the confidence included in the request, if possible and if the location information is not significantly degraded by any scaling that might be required to do this.

3.1.2. Required Civic Elements

The "requiredCivic" element represents the requirements of an LR for civic address information. An LR can specify the address elements that need to be present in the civic address in order for the location information to meet their quality requirements.

The "requiredCivic" element contains a whitespace-separated list of element names. These can be interpreted as XPath [\[W3C.REC-xpath-19991116\]](#) expressions that are evaluated in the context of the "civicAddress" element [\[RFC5139\]](#). These XPath statements are restricted to use of qualified names only (using the response document namespace context) and the "/" separator; that is, the only permitted axis is the "child::" axis. All child nodes of elements (including attributes and textual content) are treated as belonging to an element.

Figure 3 shows an example request where an LR requires country, state

(or equivalent) and post code civic address elements in the location information provided by the LS.

```
<quality xmlns="urn:ietf:params:xml:ns:geopriv:lq">
  <requiredCivic
    xmlns:ca="urn:ietf:params:xml:ns:pidf:geopriv10:civicAddr">
    ca:country ca:A1 ca:PC
  </requiredCivic>
</quality>
```

Figure 3: Example Specifying Required Civic Address Fields

Note that this does not force the LS to restrict civic address information to the indicated fields. Additional fields MAY be provided.

[3.1.3.](#) Maximum Age

Where location information is stored or cached, an LR can specify a limit on the age of this information. This is particularly important if location information is generated in advance. The "age" of location information is indicated by the the "timestamp" element in the PIDF tuple. The age parameter specifies the minimum value for this field; that is, the oldest location information that is acceptable.

Location information that has greater age than requested SHOULD either be determined anew, or checked so that the timestamp can be updated. A value of "now" can be used to indicate that stored location information is not acceptable to the LR.

[3.2.](#) Location Quality Indication

The "qualityInd" element is used in responses to indicate which of the location quality constraints from a request were met. The "qualityInd" element contains a list of the quality constraints that the accompanying location information meets.

The list of constraints is represented as a whitespace-separated list of element names. These can be interpreted as XPath [\[W3C.REC-xpath-19991116\]](#) expressions that are evaluated in the context of the original location quality request. These statements follow the same constraints as the list of elements in [Section 3.1.2.](#)

Where elements are nested, such as the "maxUncertainty" element, the outer element can be included to indicate an entire constraint is met; or, each individual child element can be identified. Two

equivalent indications are shown in Figure 4.

```
<qualityInd xmlns="urn:ietf:params:xml:ns:geopriv:lq">
  maxUncertainty
</qualityInd>

<qualityInd xmlns="urn:ietf:params:xml:ns:geopriv:lq">
  maxUncertainty/horizontal maxUncertainty/vertical
</qualityInd>
```

Figure 4: Equivalent Quality Indications

A LS that is unable to determine if a constraint MUST either omit the quality indication, or indicate that the constraint was not met.

Two special values are added to the quality indication element for convenience. The value "##all" indicates that all quality constraints were met (including any extensions). The value "##none" indicates that none of the constraints were met.

4. Location Quality Schema

Note that the pattern rules in the following schema wrap due to length constraints in RFC documents. None of the patterns contain whitespace.

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

  <xs:annotation>
    <xs:appinfo
      source="urn:ietf:params:xml:ns:geopriv:lq"
      HELD Location Quality
    </xs:appinfo>
    <xs:documentation source="http://www.ietf.org/rfc/rfcXXXX.txt">
      <!-- [[NOTE TO RFC-EDITOR: Please replace above URL with URL of
        published RFC and remove this note.]] -->
      This schema defines a framework for location quality requests
      and indications of whether they are met.
    </xs:documentation>
  </xs:annotation>

  <xs:import namespace="urn:ietf:params:xml:ns:geopriv:conf"/>

  <xs:element name="quality">
    <xs:complexType>
      <xs:complexContent>
        <xs:restriction base="xs:anyType">
          <xs:sequence>
            <xs:element ref="lq:maxUncertainty" minOccurs="0"/>
            <xs:element ref="lq:requiredCivic" minOccurs="0"/>
            <xs:element ref="lq:maxAge" minOccurs="0"/>
            <xs:any namespace="##other" processContents="lax">
```

```

        minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
</xs:restriction>
</xs:complexContent>
</xs:complexType>
</xs:element>

<xs:element name="maxUncertainty" type="lq:maxUncertaintyType"/>

```

```

<xs:complexType name="maxUncertaintyType">
  <xs:complexContent>
    <xs:restriction base="xs:anyType">
      <xs:sequence>
        <xs:element name="horizontal" type="lq:limitType"/>
        <xs:element name="vertical" type="lq:limitType"/>
      </xs:sequence>
      <xs:attribute name="confidence" type="conf:confidenceBase"
        default="95"/>
    </xs:restriction>
  </xs:complexContent>
</xs:complexType>

<xs:simpleType name="limitType">
  <xs:restriction base="xs:decimal">
    <xs:minExclusive value="0.0"/>
  </xs:restriction>
</xs:simpleType>

<xs:element name="maxAge" type="lq:maxAgeType"/>
<xs:simpleType name="maxAgeType">
  <xs:restriction base="xs:duration">
    <xs:minInclusive value="PT0S"/>
  </xs:restriction>
</xs:simpleType>

<xs:element name="requiredCivic" type="lq:elementListType"/>

<xs:element name="qualityInd" type="lq:qualityIndType"/>
<xs:simpleType name="qualityIndType">
  <xs:union memberTypes="lq:elementListType">
    <xs:simpleType>

```

```

        <xs:restriction base="xs:token">
            <xs:enumeration value="##all"/>
            <xs:enumeration value="##none"/>
        </xs:restriction>
    </xs:simpleType>
</xs:union>
</xs:simpleType>

<xs:simpleType name="elementListType">
    <xs:list>
        <xs:simpleType>
            <xs:restriction base="xs:token">
                <xs:pattern
                    value="(([\i-[:]][\c-[:]]*:?)[\i-[:]][\c-[:]]*)/*"
                    ([\i-[:]][\c-[:]]*:?)[\i-[:]][\c-[:]]*"/*"/>
            </xs:restriction>
        </xs:simpleType>
    </xs:list>
</xs:simpleType>

```

```

    </xs:simpleType>
</xs:list>
</xs:simpleType>

</xs:schema>

```

[5.](#) Security Considerations

This document does not introduce any security considerations.

[[Editor's Note: Please let us know if you can think of some.]]

[6.](#) IANA Considerations

This section registers a namespace and schema for the location quality objects.

[6.1.](#) URN Sub-Namespace Registration for urn:ietf:params:xml:ns:geopriv:lq

This section registers a new XML namespace,
"urn:ietf:params:xml:ns:geopriv:lq", as per the guidelines in
[\[RFC3688\]](#).

URI: urn:ietf:params:xml:ns:geopriv:lq

Registrant Contact: IETF, GEOPRIV working group,
(geopriv@ietf.org), Martin Thomson (martin.thomson@andrew.com).

XML:

```
BEGIN
  <?xml version="1.0"?>
  <!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Strict//EN"
    "http://www.w3.org/TR/xhtml1/DTD/xhtml1-strict.dtd">
  <html xmlns="http://www.w3.org/1999/xhtml" xml:lang="en">
    <head>
      <title>Location Quality</title>
    </head>
    <body>
      <h1>Namespace for Location Quality</h1>
      <h2>urn:ietf:params:xml:ns:geopriv:lq</h2>
      [[NOTE TO IANA/RFC-EDITOR: Please update RFC URL and replace XXXX
        with the RFC number for this specification.]]
      <p>See <a href="[[RFC URL]]">RFCXXXX</a>.</p>
    </body>
  </html>
END
```

[6.2.](#) XML Schema Registration for Location Quality Schema

This section registers an XML schema as per the guidelines in
[\[RFC3688\]](#).

URI: urn:ietf:params:xml:ns:geopriv:lq

Registrant Contact: IETF, GEOPRIV working group, (geopriv@ietf.org),
Martin Thomson (martin.thomson@andrew.com).

Schema: The XML for this schema can be found in [Section 4](#) of this document.

[7.](#) References

[7.1.](#) 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.
- [RFC5139] Thomson, M. and J. Winterbottom, "Revised Civic Location Format for Presence Information Data Format Location Object (PIDF-LO)", [RFC 5139](#), February 2008.
- [I-D.ietf-geopriv-http-location-delivery]
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- [I-D.thomson-geopriv-uncertainty]
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[7.2.](#) Informative References

- [W3C.REC-xpath-19991116]
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- [I-D.ietf-geopriv-l7-lcp-ps]
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