

Geopriv	J. Winterbottom
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[TOC](#)

Specifying Holes in LoST Service Boundaries draft-winterbottom-ecrit-specifying-holes-00.txt

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Abstract

This document describes how holes can be specified in service boundaries. One means of implementing a solution is described.

Table of Contents

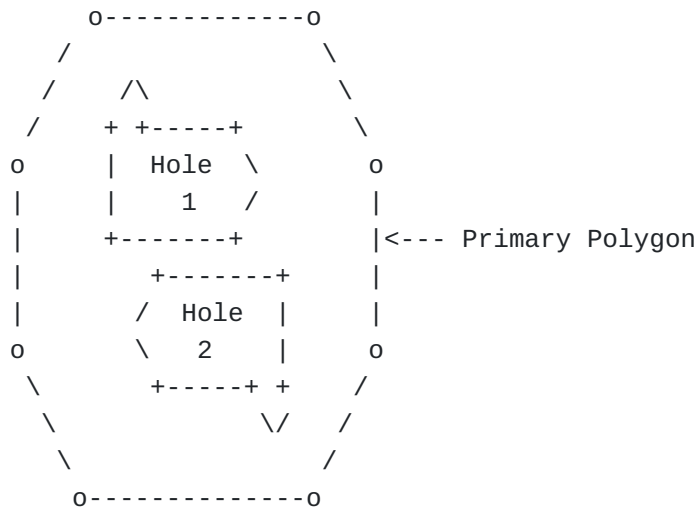
- [1.](#) Introduction
- [2.](#) Terminology
- [3.](#) Specifying Holes
- [4.](#) GML Polygons
- [5.](#) Holes in GML Polygons
- [6.](#) Service Boundary Specification and Selection Algorithm
- [7.](#) Security Considerations
- [8.](#) IANA Considerations
- [9.](#) Acknowledgements
- [10.](#) References

- [10.1. Normative References](#)
- [10.2. Informative References](#)
- [§ Authors' Addresses](#)
- [§ Intellectual Property and Copyright Statements](#)

1. Introduction

[TOC](#)

The LoST protocol [\[I-D.ietf-ecrit-lost\]](#) (Hardie, T., Newton, A., Schulzrinne, H., and H. Tschofenig, "LoST: A Location-to-Service Translation Protocol," May 2008.) describes a protocol that's primary purpose is to map service and locations to destination addresses. LoST does this by provisioning boundary maps or areas against service URNs. The boundary is a polygon made up of sets of geodetic coordinates specifying an enclosed area. In some circumstances an area enclosed by a polygon, also known as an exterior polygon, may contain exception areas, or holes, that for the same service must yield a different destination to that described by the larger area. This document describes how holes SHOULD be specified in service boundaries defined using a GML encoding for the polygons and their internal elements (holes). GML polygons are based on elements defined in [\[ISO-19107\]](#) (ISO, "Geographic information - Spatial Schema," 5 2003.).



2. Terminology

[TOC](#)

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this

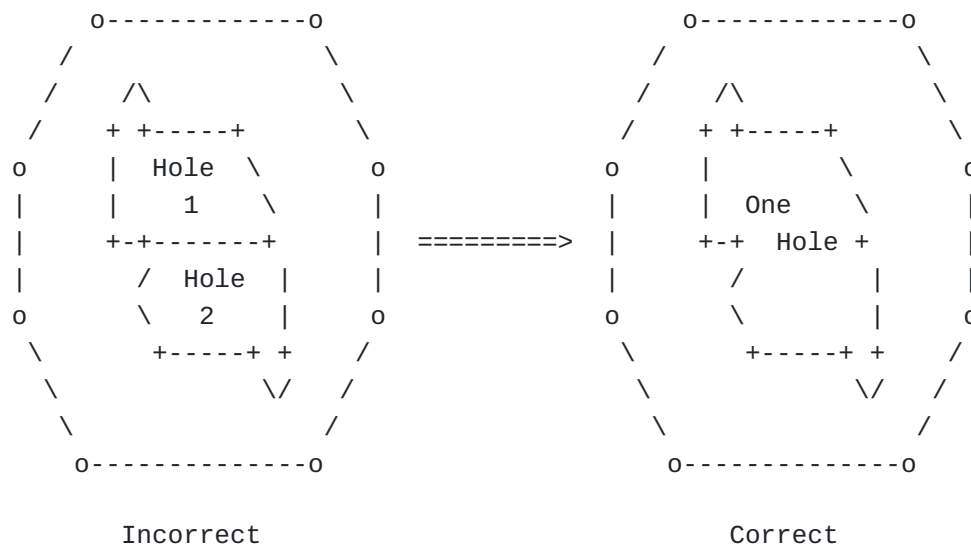
document are to be interpreted as described in [\[RFC2119\] \(Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels," March 1997.\)](#).

3. Specifying Holes

[TOC](#)

Holes related to an exterior boundary polygon MUST adhere to the following rules:

Rule 1: Two holes MUST NOT have more than one point of intersection. If two or more holes share a common set of boundaries then to the primary polygon these represent a single hole in the service. The internal elements (holes) should have common boundaries removed and a single hole created irrespective of whether the excluded area is itself made up of multiple service boundaries.



Incorrect Hole Specification with Boundary Sharing

Rule 2: A hole MUST NOT have more than one point of intersection with the outer-boundary of the primary (exterior) polygon. If more than one point of intersection occurs the primary polygon is either doesn't have a hole, it has an inlet as in [Figure 1 \(Correct Specification of an Inlet\)](#), or the primary polygon

SHOULD be expressed as two polygons as in [Figure 2 \(Correct Specification of Hole with Multiple Outer-Boundary Intersections\)](#).

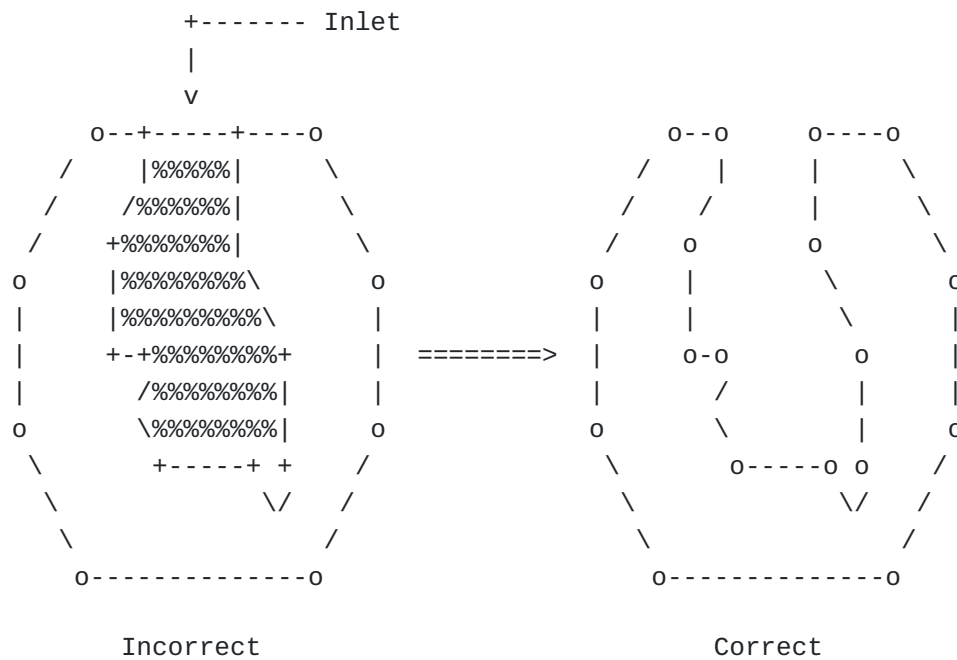


Figure 1: Correct Specification of an Inlet

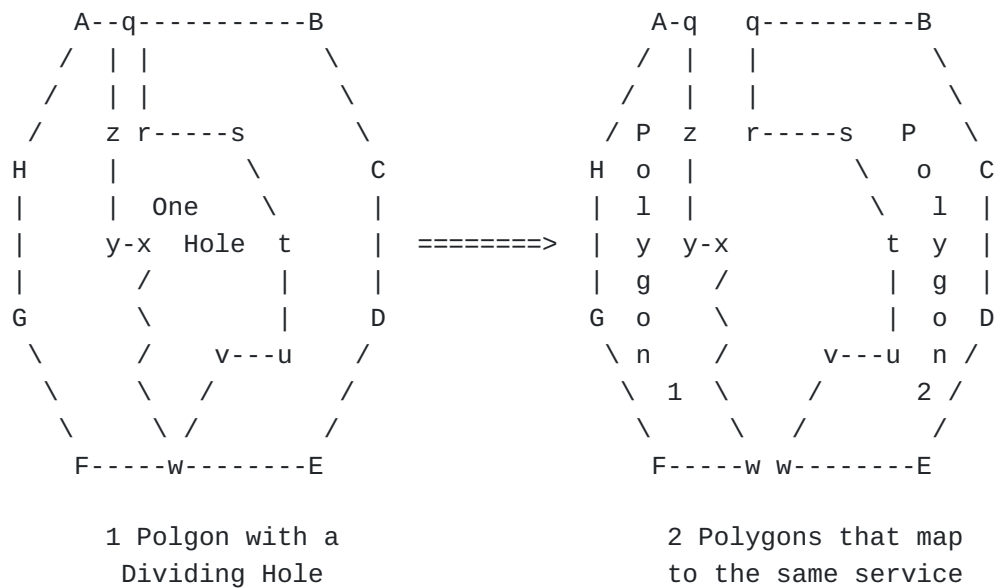


Figure 2: Correct Specification of Hole with Multiple Outer-Boundary Intersections

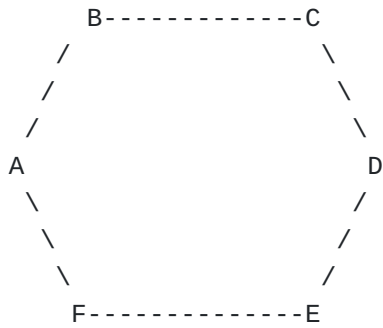
Similarly, a polygon containing a hole with an island must be represented as two polygons mapping to the same service.

Rule 3: A hole MUST be a legal polygon in accordance with the geoshape specification [\[geoshape\] \(Thomson, M. and C. Reed, "GML 3.1.1 PIDF-LO Shape Application Schema for use by the Internet Engineering Task Force \(IETF\)," April 2007.\)](#). There is no restriction on the number of points that may be used to express the perimeter of the hole.

4. GML Polygons

[TOC](#)

The GML encoding of a polygon defines a enclosed exterior boundary, with the first and last points of boundary being the same. Consider the example in [Figure 3 \(Hexagon and Associated GML\)](#).



```
<gml:Polygon srsName="urn:ogc:def:crs:EPSG::4326">
  <gml:exterior>
    <gml:LinearRing>
      <gml:pos>43.311 -73.422</gml:pos> <!--A-->
      <gml:pos>43.111 -73.322</gml:pos> <!--F-->
      <gml:pos>43.111 -73.222</gml:pos> <!--E-->
      <gml:pos>43.311 -73.122</gml:pos> <!--D-->
      <gml:pos>43.411 -73.222</gml:pos> <!--C-->
      <gml:pos>43.411 -73.322</gml:pos> <!--B-->
      <gml:pos>43.311 -73.422</gml:pos> <!--A-->
    </gml:LinearRing>
  </gml:exterior>
</gml:Polygon>
```

Figure 3: Hexagon and Associated GML

NOTE that polygon vertices in [Figure 3 \(Hexagon and Associated GML\)](#) are expressed using <pos> elements for clarity. The vertices can also be expressed using a <posList> element.

5. Holes in GML Polygons

[TOC](#)

A hole is specified in the polygon by defining an interior boundary. The points defining the internal boundary define the area represented by the hole in the primary (exterior) polygon. The shaded area in [Figure 4 \(Hexagon with Hole\)](#) is represented by the 4 points of the interior boundary specified in [Figure 5 \(GML for Hexagon with Hole\)](#).

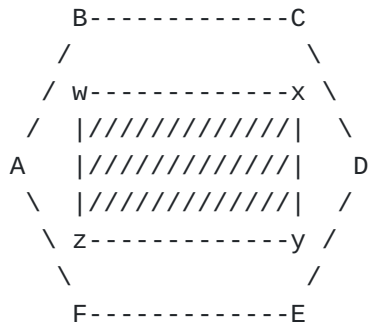


Figure 4: Hexagon with Hole

```
<gml:Polygon srsName="urn:ogc:def:crs:EPSG::4326">
  <gml:exterior>
    <gml:LinearRing>
      <gml:pos>43.311 -73.422</gml:pos> <!--A-->
      <gml:pos>43.111 -73.322</gml:pos> <!--F-->
      <gml:pos>43.111 -73.222</gml:pos> <!--E-->
      <gml:pos>43.311 -73.122</gml:pos> <!--D-->
      <gml:pos>43.511 -73.222</gml:pos> <!--C-->
      <gml:pos>43.511 -73.322</gml:pos> <!--B-->
      <gml:pos>43.311 -73.422</gml:pos> <!--A-->
    </gml:LinearRing>
  </gml:exterior>
  <gml:interior>
    <gml:LinearRing>
      <gml:pos>43.411 -73.322</gml:pos> <!--w-->
      <gml:pos>43.211 -73.322</gml:pos> <!--z-->
      <gml:pos>43.211 -73.222</gml:pos> <!--y-->
      <gml:pos>43.411 -73.222</gml:pos> <!--x-->
      <gml:pos>43.411 -73.322</gml:pos> <!--w-->
    </gml:LinearRing>
  </gml:interior>
</gml:Polygon>
```

Figure 5: GML for Hexagon with Hole

A service boundary is represented by a polygon that may have many vertices. The enclosed area of the polygon represents the area in which a service, expressed as a service URN, maps to a single URI.

[\[I-D.schulzrinne-ecrit-lost-sync\] \(Schulzrinne, H., "Synchronizing Location-to-Service Translation \(LoST\) Servers," February 2008.\)](#)

describes how LoST servers may synchronize with one another and provides examples of possible boundary exchanges and data formats. At the time of writing there is no standard format for service provisioning data into a LoST server, the format described in [\[I-D.schulzrinne-ecrit-lost-sync\] \(Schulzrinne, H., "Synchronizing Location-to-Service Translation \(LoST\) Servers," February 2008.\)](#) is used for the example in this section.

[Figure 4 \(Hexagon with Hole\)](#) shall be used to illustrate two service boundaries. The first service boundary A->F shall be referred to as area-A, and the second service boundary w->z shall be referred to as area-w. Further more area-A is directly represented by the GML encoding provided in [Figure 5 \(GML for Hexagon with Hole\)](#). Area-w is represented as a hole in area-A by the interior boundary. Since area-w is also a service boundary, a separate polygon describing this area is also required and is shown in [Figure 6 \(GML for Area-w\)](#).

```
<gml:Polygon srsName="urn:ogc:def:crs:EPSG::4326">
  <gml:exterior>
    <gml:LinearRing>
      <gml:pos>43.411 -73.322</gml:pos> <!--w-->
      <gml:pos>43.211 -73.322</gml:pos> <!--z-->
      <gml:pos>43.211 -73.222</gml:pos> <!--y-->
      <gml:pos>43.411 -73.222</gml:pos> <!--x-->
      <gml:pos>43.411 -73.322</gml:pos> <!--w-->
    </gml:LinearRing>
  </gml:exterior>
</gml:Polygon>
```

Figure 6: GML for Area-w

If this data were in a LoST server and was required in a neighbouring LoST server, the data transfer using the format in [\[I-D.schulzrinne-ecrit-lost-sync\] \(Schulzrinne, H., "Synchronizing Location-to-Service Translation \(LoST\) Servers," February 2008.\)](#) would look similar to [Figure 7 \(Service Boundary Specifications\)](#).


```

<?xml version="1.0" encoding="UTF-8"?>
  <pushMappingsRequest xmlns="urn:ietf:params:xml:ns:lost1:sync">
    <mappings>
      <mapping sourceId="lost:area-A.nsw.au.example"
        version="1" lastUpdated="2007-11-26T01:00:00Z"
        timeToLive="2007-12-26T01:00:00Z">
        <displayName xml:lang="en">
          Outer Area Police Department
        </displayName>
        <service>urn:service:sos.police</service>
        <serviceBoundary profile="geodetic-2d">
          <gml:Polygon srsName="urn:ogc:def:crs:EPSG::4326">
            <gml:exterior>
              <gml:LinearRing>
                <gml:pos>43.311 -73.422</gml:pos>
                <gml:pos>43.111 -73.322</gml:pos>
                <gml:pos>43.111 -73.222</gml:pos>
                <gml:pos>43.311 -73.122</gml:pos>
                <gml:pos>43.511 -73.222</gml:pos>
                <gml:pos>43.511 -73.322</gml:pos>
                <gml:pos>43.311 -73.422</gml:pos>
              </gml:LinearRing>
            </gml:exterior>
            <gml:interior>
              <gml:LinearRing>
                <gml:pos>43.411 -73.322</gml:pos>
                <gml:pos>43.211 -73.322</gml:pos>
                <gml:pos>43.211 -73.222</gml:pos>
                <gml:pos>43.411 -73.222</gml:pos>
                <gml:pos>43.411 -73.322</gml:pos>
              </gml:LinearRing>
            </gml:interior>
          </gml:Polygon>
        </serviceBoundary>
        <uri>sip:area-A-pd@example.com</uri>
        <uri>xmpp:area-A-pd@example.com</uri>
        <serviceNumber>000</serviceNumber>
      </mapping>
      <mapping sourceId="lost:area-w.nsw.au.example"
        version="1" lastUpdated="2007-11-26T01:00:00Z"
        timeToLive="2007-12-26T01:00:00Z">
        <displayName xml:lang="en">
          Inner Area Police Department
        </displayName>
        <service>urn:service:sos.police</service>
        <serviceBoundary profile="geodetic-2d">
          <gml:Polygon srsName="urn:ogc:def:crs:EPSG::4326">
            <gml:exterior>

```

```

        <gml:LinearRing>
          <gml:pos>43.411 -73.322</gml:pos>
          <gml:pos>43.211 -73.322</gml:pos>
          <gml:pos>43.211 -73.222</gml:pos>
          <gml:pos>43.411 -73.222</gml:pos>
          <gml:pos>43.411 -73.322</gml:pos>
        </gml:LinearRing>
      </gml:exterior>
    </gml:Polygon>
  </serviceBoundary>
  <uri>sip:area-w-pd@example.com</uri>
  <uri>xmpp:area-w-pd@example.com</uri>
  <serviceNumber>000</serviceNumber>
</mapping>
</mappings>
</pushMappingsRequest>

```

Figure 7: Service Boundary Specifications

It is considered likely that LoST servers will need to provide responses sufficiently quickly to allow real-time queries to be performed as part of an emergency call routing flow. It is for this reason that databases supporting native geospatial query techniques are desirable and that service boundary specifications that are easily mapped to internal data structures are preferred. The format described in this memo makes support for this operation easy, while allowing an arbitrary number of holes in a service boundary to be specified. Each primary polygon is stored in the geospatial database and mapped to a service URN and destination URI. Holes may be stored as polygons in a separate table and mapped to the primary polygon. When a location is found to map to a polygon, the exceptions table can be checked to see if the primary polygon contains any coverage holes. In general no holes will exist for a service boundary, so this check results in almost no overhead and the service mapping can be returned. Where one or more holes are found to exist, the provided location is checked against each hole. If the location is found to exist in one of the specified holes then the primary polygon can be discarded, and searching of the service boundary database can continue.

7. Security Considerations

[TOC](#)

This document does not introduce any security issues

8. IANA Considerations

[TOC](#)

There are no specific IANA considerations for this document.

9. Acknowledgements

[TOC](#)

Thanks to Carl Reed for input provided to the list some months back and for reviewing this document. Thanks also to Michael Haberler for suggesting that such a specification is required.

10. References

[TOC](#)

10.1. Normative References

[TOC](#)

[RFC2119]	Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels," BCP 14, RFC 2119, March 1997 (TXT , HTML , XML).
[I-D.ietf-ecrit-lost]	Hardie, T., Newton, A., Schulzrinne, H., and H. Tschofenig, " LoST: A Location-to-Service Translation Protocol ," draft-ietf-ecrit-lost-10 (work in progress), May 2008 (TXT).
[I-D.schulzrinne-ecrit-lost-sync]	Schulzrinne, H., " Synchronizing Location-to-Service Translation (LoST) Servers ," draft-schulzrinne-ecrit-lost-sync-01 (work in progress), February 2008 (TXT).
[geoshape]	Thomson, M. and C. Reed, "GML 3.1.1 PIDF-LO Shape Application Schema for use by the Internet Engineering Task Force (IETF)," Candidate OpenGIS Implementation Specification 06-142r1, Version: 1.0, April 2007.

10.2. Informative References

[TOC](#)

[ISO-19107]	ISO, "Geographic information - Spatial Schema," ISO Standard 19107, First Edition, 5 2003.
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Authors' Addresses

[TOC](#)

	James Winterbottom
	Andrew Corporation
	PO Box U40
	University of Wollongong, NSW 2500
	AU
Email:	james.winterbottom@andrew.com
	Martin Thomson
	Andrew Corporation
	PO Box U40
	University of Wollongong, NSW 2500
	AU
Email:	martin.thomson@andrew.com

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[TOC](#)

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