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A. Mayrhofer
nic.at
C. Spanring
OIR-ID
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**A Uniform Resource Identifier for Geographic Locations ('geo' URI)
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Abstract

This document specifies an Uniform Resource Identifier (URI) for geographic locations using the 'geo' scheme name. A 'geo' URI identifies a physical location by latitude, longitude and optionally altitude in a compact, simple, human-readable, and protocol independent way.

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1. Change Log

[Note to editors: This section is to be removed before publication - XML source available on request]

[draft-ietf-geopriv-geo-uri-00](#)

- o submitted as WG item
- o changed IPR text because of text used from [RFC 4395](#)
- o added considerations for comparing +180/-180 longitude URIs
- o some editorial changes

[draft-mayrhofer-geopriv-geo-uri-01](#)

- o added terminology text about WGS-84 (credits Carl Reed)
- o removed "resolution" / "uncertainty" text
- o added considerations regarding poles
- o added text about invalid URIs

[draft-mayrhofer-geopriv-geo-uri-00](#)

- o Initial version under new name, reverting to "plain" lat/lon scheme, with the "tiling" scheme moved to separate draft (potentially published as "[draft-mayrhofer-geopriv-geotile-uri](#)"). refer to [draft-mayrhofer-geo-uri-01](#) for the history of this document.
- o Added GML mapping section

[draft-mayrhofer-geo-uri-01](#)

- o removed parameters

[draft-mayrhofer-geo-uri-00](#)

- o initial draft

2. Introduction

An increasing number of Internet protocols and data formats are extended by specifications for adding spatial (geographic) location. In most cases, latitude as well as longitude of simple points are added as new attributes to existing data structures. However, all those methods are very specific to a certain data format or protocol, and don't provide a protocol independent, compact and generic way to refer to a physical geographic location.

Over the past few years, fast emerging location aware applications and location based services were observable on the Internet. Most web search engines use geographic information, and a vivid open source mapping community brought an enormous momentum into location aware technology. A wide range and former to professionals exclusive tools and data were provided free of charge for an everyday use on

the mass market.

The 'geo' URI scheme is another step into that direction and aims to facilitate, support and standardize the problem of location identification in geospatial services and applications. Accessing information about or trigger further services based on a particular place on earth shouldn't be any harder for users than clicking on a 'mailto:' link and write an email straight away.

According to [\[RFC3986\]](#), a Uniform Resource Identifier (URI) is "a compact sequence of characters that identifies an abstract or physical resource". The 'geo' URI scheme defined in this document identifies geographic locations (a physical resource) in the World Geodetic System 1984 (WGS-84) [\[WGS84\]](#) reference system.

'Geo' URIs identify a geographic location using a textual representation of the location's spatial coordinates in either two or three dimensions (latitude, longitude, and optionally altitude). Such URIs are independent from a specific protocol, application, or data format, and can be used in any other protocol or data format that supports inclusion of arbitrary URIs.

The definition of the URI scheme is strictly focused on the most simplest representation of a spatial location - a single point. The provision of more complex geometries or locations described by civic addresses is out of scope of this document.

Note: The choice of WGS-84 is based on the widespread availability of Global Positioning System (GPS) devices, which use the WGS-84 reference system. It is anticipated that such devices serve as one of the primary data sources for authoring 'geo' URIs, hence the adoption of the native GPS reference system for the URI scheme. Also, many other data formats for representing geographic locations use the WGS-84 reference system, which makes transposing from and to such data formats less error prone (no re-projection involved).

3. Terminology

Geographic locations in this document are defined using WGS 84 (World Geodetic System 1984), equivalent to the OGP Surveying and Positioning Committee EPSG code 4326 (2 dimensions) and 4979 (3 dimensions). This document does not assign responsibilities for coordinate transformations from and to other Spatial Reference Systems.

A 2-dimensional WGS-84 coordinate value is here represented as a comma-delimited latitude/longitude pair, measured in decimal degrees

(un-projected). A 3-dimensional WGS-84 coordinate value is here represented by appending a comma-delimited altitude value in meters to such pairs.

Latitudes range from -90 to 90 and longitudes range from -180 to 180. Coordinates in the Southern and Western hemispheres as well as altitudes below the WGS-84 reference geoid are signed negative with a leading dash.

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](#) [[RFC2119](#)].

4. IANA Registration of 'geo' URI Scheme

This section contains the fields required for the URI scheme registration, following the guidelines in [section 5.4 of \[RFC4395\]](#).

4.1. URI Scheme Name

geo

4.2. Status

permanent

4.3. URI Scheme Syntax

The syntax of the 'geo' URI scheme is specified below in Augmented Backus-Naur Form (ABNF) [[RFC4234](#)]:

```
geo-URI      = geo-scheme ":" geo-path
geo-scheme   = "geo"
geo-path      = geo-location

geo-location  = latitude "," longitude [ "," altitude ]

latitude     = [ "-" ] 1*2DIGIT [ "." *DIGIT ]
longitude    = [ "-" ] 1*3DIGIT [ "." *DIGIT ]
altitude     = [ "-" ] *DIGIT [ "." *DIGIT ]
```

4.4. URI Scheme Semantics

Data contained in a 'geo' URI identifies a physical resource: A spatial location on earth in the WGS-84 references system, identified by the geographic coordinates encoded in the URI.

4.4.1. Component Description

The "latitude", "longitude" and "altitude" components as specified in the URI scheme syntax ([Section 4.3](#)) are to be used as follows:

- o The "latitude" component MUST contain the latitude of the identified location in decimal degrees in the reference system WGS-84.
- o The "latitude" component MUST contain the latitude of the identified location in decimal degrees in the reference system WGS-84.
- o If present, the OPTIONAL "altitude" component MUST contain the WGS-84 altitude of the identified location in meters.

If the altitude of the location is unknown, the "altitude" component MUST NOT be present in the URI. Specifically, unknown altitude MUST NOT be represented by setting the 'altitude' component to "0" (or any other arbitrary value).

The "longitude" components of coordinate values reflecting the poles (latitude set to -90 or 90 degrees) SHOULD be set to "0", although consumers of "geo" URIs MUST accept such URIs with any longitude value between -180 and 180.

'geo' URIs with longitude values outside the range of -180 to 180 decimal degrees or with latitude values outside the range of -90 to 90 degrees MUST be considered invalid.

4.4.2. URI Comparison

Two 'geo' URIs are equal when their 'longitude', 'latitude' and 'altitude' values are mathematically identical. Where the 'latitude' component of a 'geo' URI is set to either 90 or -90 degrees, the 'longitude' component MUST be ignored in comparison operations. A 'longitude' component of 180 degrees MUST be considered equal a 'longitude' component of -180 degrees for the purpose of URI comparison.

An URI with undefined (missing) 'altitude' value MUST NOT be considered equal to an URI containing an 'altitude' value, even if the remaining values 'latitude' and 'longitude' are equivalent.

4.4.3. Interpretation of Undefined Altitude

A consumer of a 'geo' URI with undefined 'altitude' MAY assume that the URI refers to the respective location on earth's physical surface at the given 'latitude' and 'longitude' coordinate.

However, as defined above, altitudes are relative to the WGS-84

reference geoid rather than earth's surface. Hence, an altitude value of 0 MUST NOT be interpreted as "on earth's surface".

[4.5.](#) Encoding Considerations

The 'geo-location' path component of the 'geo' URI (see [Section 4.3](#)) uses a comma (",") as a delimiter for subcomponents. This delimiter MUST NOT be percent encoded.

It is RECOMMENDED that for readability the contents of 'latitude', 'longitude' and 'altitude' subcomponents are never percent encoded.

[4.6.](#) Applications/protocols That Use This URI Scheme

As many other URI scheme definitions, the 'geo' URI provides resource identification independent of a specific application or protocol. Examples of potential protocol mappings and use cases can be found in [Section 6](#).

[4.7.](#) Interopability Considerations

As with any other new URI scheme, the 'geo' URI requires support in client applications. Users of applications which are not aware of the 'geo' scheme are likely unable to make direct use of the information in the URI. However, the simple structure of the 'geo' URI would even allow manual dereference by users.

Poorly authored 'geo' URI instances could contain whitespace and values with leading plus signs ("+"), which is not allowed according to the ABNF. Clients SHOULD, however, try to dereference such URIs after removing such whitespace and plus signs.

This specification does not define any URI parameters nor a query component. Future revisions might define such parameters, using the ";" and "?" characters to delimit parameter and query components from the path component specified above. Clients MUST be prepared to encounter such 'geo' URI instances, and MUST reduce the URI to the components specified in [Section 4.3](#) before they dereference the URI.

[4.8.](#) Security Considerations

See [Section 9](#) of [insert reference to this document]

[4.9.](#) Contact

Christian Spanring (mailto:cspanring@gmail.at, <http://spanring.eu/>),
Alexander Mayrhofer (mailto:alexander.mayrhofer@nic.at,
<http://timatio.com/>)

4.10. Author/Change controller

The 'geo' URI scheme is registered under the IETF part of the URI tree. As such, change control is up to the IETF.

4.11. References

RFC XXXX [change to RFC number once assigned]

5. URI Operations

Currently, just one operation on a 'geo' URI is defined - location dereference: In that operation, a client dereferences the URI by extracting the geographical coordinates from the URI path component ('geo-path' in the ABNF). Further use of those coordinates is then up to the application processing the URI, and might depend on the context of the URI.

An application may then use this location information for various purposes, for example:

- o A web browser could use that information to open a web mapping service of the user's choice, and display a map of the location
- o A navigational device such as a Global Positioning System (GPS) receiver could offer the user to start navigation to the location.

6. Use Cases and Examples

6.1. Plain 'geo' URI Example

The following 3-dimensional 'geo' URI example references to the office location of one of the authors in Vienna, Austria:

geo:48.2010,16.3695,183

A user could type the data extracted from this URI into a electronic navigation device, or even use it to locate the identified location on a paper map.

6.2. Hyperlink

'geo' URIs (like any other URI scheme) could also be embedded as hyperlinks in web pages. A Hyper Text Markup Language (HTML) snippet with such a hyperlink could look like:

<p>one of Vienna's popular sights is the Karlskirche.

A web browser could extract the coordinates from the HTML snippet, and offer the user various options (based on configuration, context), for example:

- o display a small map thumbnail when the mouse pointer hovers over the link
- o switch to a mapping service of the user's choice once the link is selected
- o Locate nearby resources, for example by comparing the 'geo' URI with locations extracted from GeoRSS feeds the user has subscribed to.
- o Convert the coordinates to a format suitable for uploading to a navigation device

6.3. 'geo' URI in 2-dimensional barcode

Due to its short length, a 'geo' URI could easily be encoded in 2-dimensional barcodes. Such barcodes could be printed on business cards, flyers, paper maps and subsequently used by mobile devices, for example as follows:

1. User identifies such a barcode on a flyer, uses the camera on his mobile phone to photograph and decode the barcode
2. The mobile phone dereferences the 'geo' URI, and offers the user to calculate a navigation route to the identified location.
3. Using the builtin GPS, the user follows the navigation instructions from his phone to reach the destination

7. GML Mappings

The Geographic Markup Language (GML) by the Open Geospatial Consortium (OGC) is a set of XML schemas to represent geographical features. Since GML is widely accepted, this document includes instructions on how to transpose 'geo' URIs from and to GML documents.

A 'geo' URI can be authored from a GML "point", and any 'geo' URI can be mapped to a GML "point". For the following sections, "%lat%", "%lon%" and "%alt%" are placeholders for latitude, longitude, and

altitude values. Mappings are defined as follows:

7.1. 'geo' URI without altitude to GML 'Point'

An instance of the 'geo' URI without the altitude element is mapped to a two-dimensional GML "Point" as follows:

'geo' URI:

geo:%lat%,%lon%

GML document:

```
<?xml version="1.0" encoding="UTF-8">
<Point srsDimension="2"
      srsName="urn:ogc:def:crs:EPSG:6.6:4326"
      xmlns="http://www.opengis.net/gml">
  <pos>%lat% %lon%</pos>
</Point>
```

7.2. 'geo' URI with Altitude to GML 'Point'

A 'geo' URI instance with the altitude element is mapped to a three-dimensional GML "Point" as follows:

'geo' URI:

geo:%lat%,%lon%,%alt%

GML document:

```
<?xml version="1.0" encoding="UTF-8">
<Point srsDimension="3"
      srsName="urn:ogc:def:crs:EPSG:6.6:4979"
      xmlns="http://www.opengis.net/gml">
  <pos>%lat% %lon% %alt%</pos>
</Point>
```

7.3. GML 'Point' without Altitude to 'geo' URI

A GML 'Point' in the reference system identified as "urn:ogc:def:crs:EPSG:6.6:4326" is mapped to a 'geo' URI as follows:

GML document:


```
<?xml version="1.0" encoding="UTF-8">
<Point srsDimension="2"
      srsName="urn:ogc:def:crs:EPSG:6.6:4326"
      xmlns="http://www.opengis.net/gml">
  <pos>%lat% %lon%</pos>
</Point>
```

'geo' URI:

geo:%lat%,%lon%

Note: GML documents in other reference systems MAY be used as well if a transformation into "urn:ogc:def:crs:EPSG:6.6:4326" is defined and applied before the mapping step.

7.4. GML 'Point' with Altitude to 'geo' URI

A GML 'Point' in the reference system identified as "urn:ogc:def:crs:EPSG:6.6:4979" is mapped to a 'geo' URI as follows:

GML document:

```
<?xml version="1.0" encoding="UTF-8">
<Point srsDimension="3"
      srsName="urn:ogc:def:crs:EPSG:6.6:4979"
      xmlns="http://www.opengis.net/gml">
  <pos>%lat% %lon%</pos>
</Point>
```

'geo' URI:

geo:%lat%,%lon%

Note: GML 'Point' instances in other reference systems MAY be used as well if a transformation into "urn:ogc:def:crs:EPSG:6.6:4979" is defined and applied before the mapping step.

8. IANA Considerations

This document requests assignment of the 'geo' URI scheme in the IETF part of the URI scheme tree, according to the guidelines in [BCP 115](#) ([RFC 4395](#)) [[RFC4395](#)]. The definitions required for the assignment are contained in [Section 4](#).

9. Security Considerations

Because the 'geo' URI is not tied to any specific protocol, and identifies a physical location rather than a network resource, most of the general security considerations on URIs (Section 7 of [RFC 3986](#)) do not apply. However, the following (additional) issues apply:

9.1. Invalid Locations

The URI syntax ([Section 4.3](#)) makes it possible to construct valid 'geo' URIs which don't identify a valid location on earth. Applications MUST NOT use URIs which such invalid values, and SHOULD warn the user when such URIs are encountered.

An example of such an invalid URI would be <geo:94,0> (latitude "beyond" north pole).

9.2. Location Privacy

Location information about individuals is an extremely sensitive topic, especially when location is combined with Personally Identifiable Information (PII). Authors of 'geo' URIs MUST consider data protection and privacy before publishing such URIs.

10. Acknowledgements

The authors wish to acknowledge the helpful contributions from Carl Reed, Bill McQuillan, Martin Kofal, Andrew Turner and Kim Sanders.

11. References

11.1. Normative References

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Authors' Addresses

Alexander Mayrhofer
nic.at GmbH
Karlsplatz 1/9
Wien A-1010
Austria

Phone: +43 1 5056416 34
Email: alexander.mayrhofer@nic.at
URI: <http://www.nic.at/>

Christian Spanring
OIR-ID GmbH
Franz-Josefs-Kai 27
Wien A-1010

Phone: +43 1 5338747 36
Email: cspanring@gmail.com
URI: <http://www.oir.at/>

