                    LISP Geo-Coordinate Use-Cases
                      draft-farinacci-lisp-geo-11

Abstract

   This draft describes how Geo-Coordinates can be used in the LISP
   Architecture and Protocols.

Status of This Memo

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1. Introduction

   The LISP architecture and protocols [RFC6830] introduces two new
   numbering spaces, Endpoint Identifiers (EIDs) and Routing Locators
   (RLOCs) which are intended to replace most use of IP addresses on the
   Internet. To provide flexibility for current and future
   applications, these values can be encoded in LISP control messages
   using a general syntax that includes Address Family Identifier (AFI)
   [RFC1700].

   This specification introduces the use of Geo-Coordinates that can be
   used in EID-records and RLOC-records of LISP control messages. The
   encoding format is specified in [RFC8060] as the "Geo-Coordinates
   LCAF Type".

2. Definition of Terms

   Geo-Point is a Geo-Coordinate according to [GEO] that defines a
      point from parameters Latitude, Longitude, and Altitude.

Geo-Prefix forms a circle of a geographic area made up of a Geo-
   Point and a Radius. A Geo-Point is known to be "more-specific"
   than a Geo-Prefix when its physical location is within the
   geographic circle.

3. Geo-Points in RLOC-records

Geo-Points can accompany an RLOC-record to determine the physical
location of an ETR or RTR. This can aid in determining geographical
distance when topological distance is inaccurate or hidden. When
Geo-Points are encoded in RLOC-records with RLOC addresses the LCAF
AFI-List Type should be used.

Geo-Points can be used as the sole piece of information in an RLOC-
record when an EID maps to a Geo-Coordinate. If it is desirable to
find the geographical location of any EID, this method can be
convienent.

   Here is a high-level use-case where an EID that maps to a Geo-
   Coordinate can be used. Lets say that am EID is assigned to a
   physical shipping package by a package delivery company. And the EID
   is encoded as an IPv6 address where the tracking number is embedded
   in an IPv6 EID. The network has LISP nodes deployed in many
   locations that are configured with their respective Geo-Coordinates.
   As the package roams, the LISP node that discovers the EID, registers
   it to the LISP mapping system. The EID-to-RLOC mapping is EID=IPv6
   and RLOC=Geo-Coordinate. If someone does a mapping database lookup
   on the IPv6 EID, what is returned is the Geo-Coordinate. As the EID
   roams, new registrations with different Geo-Coordinates are stored,
   allowing the physical tracking of the package.

4. Geo-Prefixes in EID-records and RLOC-records

   A Geo-Prefix is defined to be a Geo-Coordinate point and a Radius.
   This allows a circle to be drawn on a geographic map. The Geo-Prefix
   can describe a coarse physical location for an RLOC when encoded in
   an RLOC-record. So an RLOC could be registered in the mapping
   database indicating it is in a city or country versus the exact
   location where a Geo-Point would locate it.

   A Geo-Prefix could allow a Distinguished-Name
   [I-D.farinacci-lisp-name-encoding] to be registered as an EID with an
   RLOC that contains a Geo-Prefix. For example EID="San Francisco",
   with RLOC=geo-prefix could be stored in the mapping system.

   A Geo-Prefix, when encoded in an EID-record, could be registered as
   an EID-prefix and when a Geo-Point is used as an EID lookup key, a
   sort of longest match could be looked up. If the Geo-Point is in the
   Circle described by the Geo-Prefix, an entry is returned to the Map-
   Requestor.

You could take a combination of mappings from the above examples to
ask the question: "Is the package in San Francisco"? This could be
done with two lookups to the mapping system:

```
Contents of Mapping Database:
  EID=<dist-name="san francisco">
  RLOC=<geo-prefix-of-60-mile-radius-of-sf>

  EID=<ipv6-package-tracking-number>
  RLOC=<geo-point-of-current-location>

  EID=<geo-prefix-of-60-mile-radius-of-sf>
  RLOC=<dist-name="san francisco">

Map-Request for package:
  EID=<ipv6-package-tracking-number>
Mapping system returns:
  RLOC=<geo-point-of-current-location>

Map-Request for geo-point:
  EID=<geo-point-of-current-location>
Mapping system longest-match lookup returns:
  EID=<geo-prefix-of-60-mile-radius-of-sf>
  RLOC=<dist-name="san francisco">
```

If the package was not in San Francisco, the second mapping table
lookup would fail.

Another application is concentric rings of WiFi access-points. The
radius of each ring corresponds to the Wifi signal strength. An EID
could be located in any on the inner rings but possibly on the edge
of a ring. A WiFi access-point RLOC can be selected to encapsulate
packets to because it will have better signal to the current EID
location. And when there are intersecting circles, it can be
determined that when the EID is in the intersection of the circles,
it would be a good time to transition radios to closer APs or base
stations.

When assigning EIDs to vehicles
[I-D.jeong-its-v2i-problem-statement], a Geo-Prefix could be used to
create a "reachability set" of Road-Side-Units (RSUs). So an ITR
could encapsulate to multiple RLOCs in the Geo-Prefix to try to
create connectivity to the vehicle while roaming. This makes use of
predictive RLOCs that can be used when the direction of the roaming
EID is known (a train track or single direction road, but not a
flight path of a plane).

5. Geo-Prefix and Geo-Point Encodings

   When a Geo-Prefix or a Geo-Point are encoded in an EID-record, it is
   encoded solely with the Geo-Coordinates LCAF Type format when VPNs
   are not in use. When VPNs are used, the Geo-Coordinate LCAF Type is
   encoded within an Instance-ID LCAF Type.

```
    0                   1                   2                   3
    0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |           AFI = 16387         |     Rsvd1     |     Flags     |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |   Type = 5    |     Rsvd2     |            Length             |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |U|N|E|A|M|R|K|   Reserved      |     Location Uncertainty      |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   | Lat Degrees  |        Latitude Milliseconds                  |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   | Long Degrees |        Longitude Milliseconds                 |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |                            Altitude                          |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |             Radius           |             Reserved          |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |            AFI = x            |           Address  ...        |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
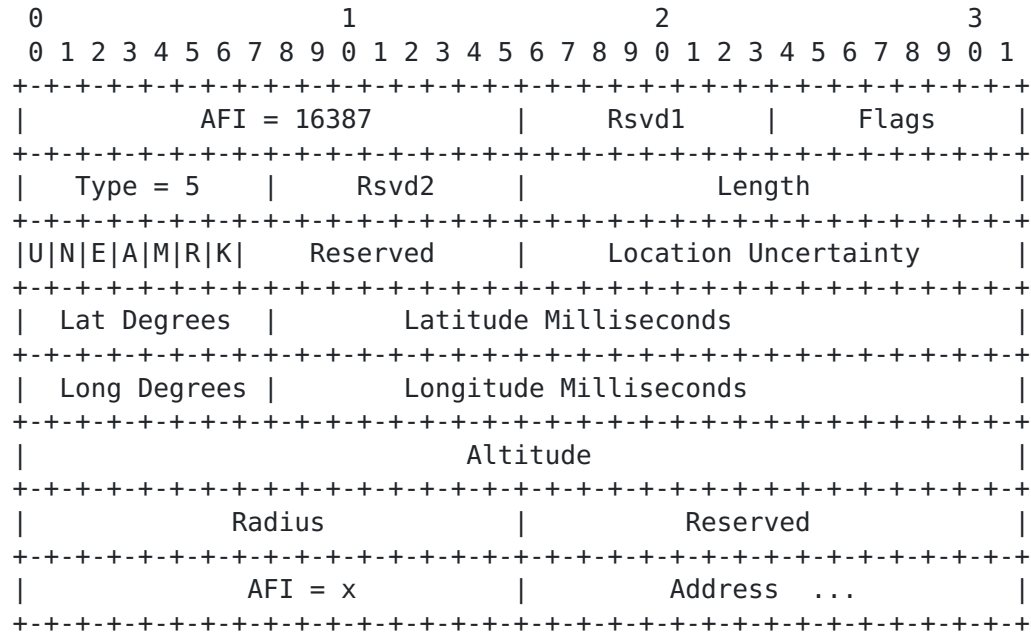
   Rsvd1/Rsvd2/Flags: See [RFC8060] for details.

   Length: length in bytes starting and including the byte after this
      Length field.

   U-bit: If the U-bit is set, it indicates that the "Location
      Uncertainty" field is specified. If the U-bit is clear, it
      indicates the "Location Uncertainty" field is unspecified.

   N-bit: If the N-bit is set, it indicates the Latitude is north
      relative to the Equator. If the N-bit is clear, it indicates the
      Latitude is south of the Equator.

   E-bit: If the E-bit is set, it indicates the Longitude is east of
      the Prime Meridian. If the E-bit is clear, it indicates the
      Longitude is west of the Prime Meridian.

   A-bit: If the A-bit is set, it indicates the "Altitude" field is
      specified. If the A-bit is clear, it indicates the "Altitude"
      field is unspecified.

M-bit: If the M-bit is set, it indicates the "Altitude" is specified
   in meters. If the M-bit is clear, it indicates the "Altitude" is
   in centimeters.

R-bit: If the R-bit is set, it indicates the "Radius" field is
   specified and the encoding is a Geo-Prefix. If the R-bit is
   clear, it indicates the "Radius" field is unspecified and the
   encoding is a Geo-Point.

K-bit: If the K-bit is set, it indicates the "Radius" is specified
   in kilometers. If the K-bit is clear, it indicates the "Radius"
   is in meters.

Reserved: These bits are reserved. They SHOULD be set to 0 when
   sending protocol packets and MUST be ignored when receiving
   protocol packets.

Location Uncertainty: Unsigned 16-bit integer indicating the number
   of centimeters of uncertainty for the location.

Latitude Degrees: Unsigned 8-bit integer with a range of 0 - 90
   degrees north or south of the Equator (northern or southern
   hemisphere, respectively).

Latitude Milliseconds: Unsigned 24-bit integer with a range of 0 -
   3,599,999 (i.e., less than 60 minutes).

Longitude Degrees: Unsigned 8-bit integer with a range of 0 - 180
   degrees east or west of the Prime Meridian.

Longitude Milliseconds: Unsigned 24-bit integer with a range of 0 -
   3,599,999 (i.e., less than 60 minutes).

Altitude: Signed 32-bit integer containing the Height relative to
   sea level in centimeters or meters. A negative height indicates
   that the location is below sea level.

Radius: Unsigned 16-bit integer containing the radius of a circle
   (or sphere) centered at the specified coordinates. The radius is
   specified in meters unless the K-bit is specified indicating
   radius is in kilometers. When the radius is specified, this LCAF
   type encodes a Geo-Prefix where the geo-coordinates define the
   entire area of the circle defined by the radius and center point.

AFI = x: x can be any AFI value from [AFI] and [RFC8060].

6. Security Considerations

   The use of Geo-Coordinates in any application must be considered
   carefully to not violate any privacy concerns about physical
   location. This draft does take into consideration the applicability
   of BCP160 [RFC6280] for location-based privacy protection.

   In a LISP environment, Geo-Coordinates can be registered to the
   Mapping Database System. When this occurs, an xTR is allowing its
   physical location to be known to queriers of the mapping system as
   well as network components that make up the mapping system. There
   are various sets of trust relationships that may exist.

   An xTR at a LISP site already has a business and trust relationship
   with its Mapping Service Provider (MSP). When xTRs register their
   mappings with Geo-Coordinate information, a policy is agreed upon
   about who can access the information. Typically, the policy is
   stored locally and processed by the xTR when the MSP forwards Map-
   Requests to the xTRs of the LISP site. Conditionally, based on the
   requesting xTR, the responding xTR can apply the local policy to
   decide if a Map-Reply is sent with all RLOC-records, or perhaps, the
   RLOC-records that do not contain Geo-Coordinate information.

   The MSP can also be requested by LISP site xTRs to proxy Map-Reply to
   Map-Requests. In this case, the MSP must apply the xTR policy so
   only authorized requesters get access to Geo-Coordinate information.

   Note that once a requester is authorized, Map-Replies are returned
   directly to the requester and are signed with [I-D.ietf-lisp-sec].
   The Map-Replies not only authenticates the Map-Replier but can be
   encrypted by the Map-Replier so no eavesdropping of Geo-Coordinate
   information can occur.

7. IANA Considerations

   At this time there are no specific requests for IANA.

8. References

8.1. Normative References

   [GEO]   Geodesy and Geophysics Department, DoD., "World Geodetic
              System 1984", NIMA TR8350.2, January 2000, <http://earth-
              info.nga.mil/GandG/publications/tr8350.2/wgs84fin.pdf>.

   [RFC1700] Reynolds, J. and J. Postel, "Assigned Numbers", RFC 1700,
              DOI 10.17487/RFC1700, October 1994,
              <https://www.rfc-editor.org/info/rfc1700>.

[RFC6280]   Barnes, R., Lepinski, M., Cooper, A., Morris, J.,
            Tschofenig, H., and H. Schulzrinne, "An Architecture for
            Location and Location Privacy in Internet Applications",
            BCP 160, RFC 6280, DOI 10.17487/RFC6280, July 2011,
            <https://www.rfc-editor.org/info/rfc6280>.

[RFC6830]   Farinacci, D., Fuller, V., Meyer, D., and D. Lewis, "The
            Locator/ID Separation Protocol (LISP)", RFC 6830,
            DOI 10.17487/RFC6830, January 2013,
            <https://www.rfc-editor.org/info/rfc6830>.

[RFC8060]   Farinacci, D., Meyer, D., and J. Snijders, "LISP Canonical
            Address Format (LCAF)", RFC 8060, DOI 10.17487/RFC8060,
            February 2017, <https://www.rfc-editor.org/info/rfc8060>.

8.2. Informative References

[AFI]   "Address Family Identifier (AFIs)", ADDRESS FAMILY
            NUMBERS http://www.iana.org/assignments/address-family-
            numbers/address-family-numbers.xhtml?, Febuary 2007.

[I-D.acee-ospf-geo-location]
            Lindem, A., Shen, N., and E. Chen, "OSPF Extensions for
            Advertising/Signaling Geo Location Information", draft-
            acee-ospf-geo-location-05 (work in progress), October
            2017.

[I-D.chen-idr-geo-coordinates]
            Chen, E., Shen, N., and R. Raszuk, "Carrying Geo
            Coordinates in BGP", draft-chen-idr-geo-coordinates-02
            (work in progress), October 2016.

[I-D.farinacci-lisp-name-encoding]
            Farinacci, D., "LISP Distinguished Name Encoding", draft-
            farinacci-lisp-name-encoding-11 (work in progress),
            November 2020.

[I-D.ietf-lisp-sec]
            Maino, F., Ermagan, V., Cabellos-Aparicio, A., and D.
            Saucez, "LISP-Security (LISP-SEC)", draft-ietf-lisp-sec-22
            (work in progress), January 2021.

[I-D.jeong-its-v2i-problem-statement]
            Jeong, J. and T. Oh, "Problem Statement for Vehicle-to-
            Infrastructure Networking", draft-jeong-its-v2i-problem-
            statement-02 (work in progress), July 2016.

[I-D.shen-isis-geo-coordinates]
          Shen, N. and E. Chen, "Carrying Geo Coordinates
          Information In IS-IS", draft-shen-isis-geo-coordinates-04
          (work in progress), October 2017.

Appendix A. Acknowledgments

The author would like to thank the LISP WG for their review and
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A special thanks goes to Enke Chen, Acee Lindem, and Naiming Shen for
collaboarting on a consistent geo-location encoding format with OSPF
[I-D.acee-ospf-geo-location], IS-IS [I-D.shen-isis-geo-coordinates],
and BGP [I-D.chen-idr-geo-coordinates] protocols.

Appendix B. Document Change Log

[RFC Editor: Please delete this section on publication as RFC.]

B.1. Changes to draft-farinacci-lisp-geo-11

o Posted March 2021.

o Update document timer and references.

B.2. Changes to draft-farinacci-lisp-geo-10

o Posted October 2020.

o Update document timer and references.

B.3. Changes to draft-farinacci-lisp-geo-09

o Posted April 2020.

o Update document timer and references.

B.4. Changes to draft-farinacci-lisp-geo-08

o Posted October 2019.

o Update document timer and references.

B.5. Changes to draft-farinacci-lisp-geo-07

o Posted April 2019.

o Update document timer and references.

B.6. **Changes to draft-farinacci-lisp-geo-06**

   o Posted October 2018.

   o Update document timer and references.

B.7. **Changes to draft-farinacci-lisp-geo-05**

   o Posted April 2018.

   o Update document timer and references.

B.8. **Changes to draft-farinacci-lisp-geo-04**

   o Posted October 2017.

   o Update document timer and references.

B.9. **Changes to draft-farinacci-lisp-geo-03**

   o Posted April 2017.

   o Update document timer.

B.10.   **Changes to draft-farinacci-lisp-geo-02**

   o Posted October 2016.

   o Change format of the Geo-Coordinates LCAF Type to be compatible
      with equivalent proposals for OSPF, IS-IS, and BGP.

   o Add to the Security Considerations section to BCP160 compliance.

B.11.   **Changes to draft-farinacci-lisp-geo-01**

   o Posted October 2016.

   o Clarify that the Geo-Coordinates LCAF type should be encoded
      inside an Instance-ID LCAF type when VPNs are used.

   o Indiate what the value of the Altitude field is when not included
      in a message. Since this draft shortens the field, a new value is
      specified in this draft for not conveying an Altitude value in a
      message.

B.12. Changes to draft-farinacci-lisp-geo-00

   o Initial draft posted April 2016.

Author's Address

   Dino Farinacci
   lispers.net
   San Jose, CA
   USA

   Email: farinacci@gmail.com