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BSI Standards Publication

Intelligent transport systems — Traffic and travel information (TTI) via transport protocol experts group, generation 2 (TPEG2)

Part 22: OpenLR location referencing (TPEG2-OLR)

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National foreword

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Part 22: OpenLR location referencing (TPEG2-OLR)

Systèmes intelligents de transport — Informations sur le trafic et le tourisme via le groupe expert du protocole de transport, génération 2 (TPEG2) —

Partie 22: Référencement d'Emplacement OpenLR (TPEG2-OLR)

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 204, *Intelligent transport systems*.

A list of all parts in the ISO 21219 series can be found on the ISO website.

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Introduction

History

TPEG technology was originally proposed by the European Broadcasting Union (EBU) Broadcast Management Committee, who established the B/TPEG project group in the autumn of 1997 with a brief to develop, as soon as possible, a new protocol for broadcasting traffic and travel-related information in the multimedia environment. TPEG technology, its applications and service features were designed to enable travel-related messages to be coded, decoded, filtered and understood by humans (visually and/or audibly in the user's language) and by agent systems. Originally, a byte-oriented data stream format, which may be carried on almost any digital bearer with an appropriate adaptation layer, was developed. Hierarchically structured TPEG messages from service providers to end-users were designed to transfer information from the service provider database to an end-user's equipment.

One year later, in December 1998, the B/TPEG group produced its first EBU specifications. Two documents were released. Part 2 (TPEG-SSF, which became ISO/TS 18234-2) described the syntax, semantics and framing structure, which was used for all TPEG applications. Meanwhile, Part 4 (TPEG-RTM, which became ISO/TS 18234-4) described the first application for road traffic messages.

Subsequently, in March 1999, CEN/TC 278, in conjunction with ISO/TC 204, established a group comprising members of the former EBU B/TPEG and this working group continued development work. Further parts were developed to make the initial set of four parts, enabling the implementation of a consistent service. Part 3 (TPEG-SNI, ISO/TS 18234-3) described the service and network information application used by all service implementations to ensure appropriate referencing from one service source to another.

Part 1 (TPEG-INV, ISO/TS 18234-1) completed the series by describing the other parts and their relationship; it also contained the application IDs used within the other parts. Additionally, Part 5, the public transport information application (TPEG-PTI, ISO/TS 18234-5), was developed. The so-called TPEG-LOC location referencing method, which enabled both map-based TPEG-decoders and non-map-based ones to deliver either map-based location referencing or human readable text information, was issued as ISO/TS 18234-6 to be used in association with the other applications parts of the ISO/TS 18234 series to provide location referencing.

The ISO/TS 18234 series has become known as TPEG Generation 1.

TPEG Generation 2

When the Traveller Information Services Association (TISA), derived from former forums, was inaugurated in December 2007, TPEG development was taken over by TISA and continued in the TPEG applications working group.

It was about this time that the (then) new Unified Modelling Language (UML) was seen as having major advantages for the development of new TPEG applications in communities who would not necessarily have binary physical format skills required to extend the original TPEG TS work. It was also realized that the XML format for TPEG described within the ISO/TS 24530 series (now superseded) had a greater significance than previously foreseen, especially in the content-generation segment and that keeping two physical formats in synchronism, in different standards series, would be rather difficult.

As a result, TISA set about the development of a new TPEG structure that would be UML based. This has subsequently become known as TPEG Generation 2.

TPEG2 is embodied in the ISO/TS 21219 series and it comprises many parts that cover introduction, rules, toolkit and application components. TPEG2 is built around UML modelling and has a core of rules that contain the modelling strategy covered in ISO/TS 21219-2, ISO/TS 21219-3 and ISO/TS 21219-4 and the conversion to two current physical formats: binary and XML; others could be added in the future. TISA uses an automated tool to convert from the agreed UML model XMI file directly into an MS Word document file, to minimize drafting errors, that forms the annex for each physical format.

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TPEG2 has a three container conceptual structure: message management (ISO/TS 21219-6), application (several parts) and location referencing (ISO/TS 21219-7). This structure has flexible capability and can accommodate many differing use cases that have been proposed within the TTI sector and wider for hierarchical message content.

TPEG2 also has many location referencing options as required by the service provider community, any of which may be delivered by vectoring data included in the location referencing container.

The following classification provides a helpful grouping of the different TPEG2 parts according to their intended purpose.

— Toolkit parts: TPEG2-INV (ISO/TS 21219-1), TPEG2-UML (ISO/TS 21219-2), TPEG2-UBCR (ISO/TS 21219-3), TPEG2-UXCR (ISO/TS 21219-4), TPEG2-SFW (ISO/TS 21219-5), TPEG2-MMC (ISO/TS 21219-6), TPEG2-LRC (ISO/TS 21219-7), TPEG2-LTE (ISO/TS 21219-24).

— Special applications: TPEG2-SNI (ISO/TS 21219-9), TPEG2-CAI (ISO/TS 21219-10).

— Location referencing: TPEG2-ULR (ISO/TS 21219-11[1)]), TPEG2-GLR (ISO/TS 21219-21[1)]), TPEG2-OLR (ISO/TS 21219-22).

— Applications: TPEG2-PKI (ISO/TS 21219-14), TPEG2-TEC (ISO/TS 21219-15), TPEG2-FPI (ISO/TS 21219-16), TPEG2-TFP (ISO/TS 21219-18), TPEG2-WEA (ISO/TS 21219-19), TPEG2-RMR (ISO/TS 21219-23), TPEG2-EMI (ISO/TS 21219-25).

TPEG2 has been developed to be broadly (but not totally) backward compatible with TPEG1 to assist in transitions from earlier implementations, while not hindering the TPEG2 innovative approach and being able to support many new features, such as dealing with applications having both long-term, unchanging content and highly dynamic content, such as parking information.

This document is based on the TISA specification technical/editorial version reference: SP14006/1.0/002.

1) Under development.

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Intelligent transport systems — Traffic and travel information (TTI) via transport protocol experts group, generation 2 (TPEG2) —

Part 22:
OpenLR location referencing (TPEG2-OLR)

1 Scope

This document specifies the logical data format of OpenLR™ location references and general requirements of the method in Clause 6 and defines the structure of the TPEG toolkit for OpenLR location referencing (OLR) in Clauses 7, 8 and 9. The toolkit is intended to be used in the TPEG location referencing container (TPEG-LRC).

OpenLR™ has been designed for the use case of transferring traffic information from a centre to in-vehicle systems, built-in or used as an add-on (PND, smart phone). The information transferred can consist of the current traffic situation at a certain location, a traffic forecast or special alerts. The corresponding locations are roads, a list of connected roads, points of interest, or areas.

In order to transmit location information from a sending to a receiving side, the OpenLR™ method defines rules for generating map-independent location references, that is, the actual location references are generated dynamically not requiring use of pre-defined location references.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/TS 21219-1, *Intelligent transport systems — Traffic and travel information (TTI) via transport protocol experts group, generation 2 (TPEG2) — Part 1: Introduction, numbering and versions (TPEG2-INV)*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at http://www.iso.org/obp

3.1
area
two-dimensional part of the surface of the earth which is bounded by a closed curve

Note 1 to entry: An area may cover parts of the road network, covering several roads or parts of roads.

3.2
decoder
software component which decodes a location code and finds the corresponding location back in a map

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3.3
encoder
software component which generates a location code for a location in a map

3.4
intermediate/intermediate location reference point
internal location reference point (LRP) which is neither the start LRP nor the end LRP

3.5
line
one-dimensional representation of a road or part of road in a road network

Note 1 to entry: A line starts and ends at a node. It is directed. This means two-way traffic flows are represented by two (directed) lines, one per direction.

3.6
location
specification of the position on the earth surface of an object in a digital map

3.7
location reference
location code, created according to a specific set of rules, used to reference a location

3.8
location reference path
route in a road network in a digital map which is referenced by the location reference

Note 1 to entry: Note1 to entry: This path might be longer than the location itself.

3.9
location reference point
point representing a real-world point location

Note 1 to entry: Besides the position or line information, additional data may be used to further specify the character of a location.

3.10
map
geospatial representation of an area on the earth surface

3.11
node
zero-dimensional object in the road network acting as start and end for lines

3.12
offset
specification of a position along a referenced path to indicate the start or the end of a location

3.13
orientation
describes the relationship between a point of interest and the direction of a referenced line

Note 1 to entry: The point may be directed in the same direction as the line, against that direction, in both directions, or the direction of the point might be unknown.

3.14
point
zero-dimensional element that specifies a spatial location by a coordinate pair

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3.15
route
collection of line objects in a digital map connecting a departure location and a destination location, defined according to certain criteria which might include time distance or cost

3.16
side of road
relationship between a point of interest and a referenced line

Note 1 to entry: The point can be on the right side of the reference line, on the left side of the reference line, on both sides of the reference line or directly on the reference line, in the position direction of the reference line.

4 Abbreviated terms

ADD	against driving direction
BEAR	bearing
CEN	Comité Européen de Normalisation
COORD	coordinates
DESC	location description
DNP	distance to next point
FOW	form of way
FRC	functional road class
FUZ	fuzzy area
lat	latitude
LFRCNP	lowest functional road class to next point
lon	longitude
LRP	location reference point
LRC	location reference container
n.a.	not available
NCOLS	number of columns
NOFF	negative offset
NROWS	number of rows
ORI	orientation
POFF	positive offset
POI	point of interest
RAD	radius
SFW	TPEG service framework: modelling and conversion rules

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SHP	shape
SOR	side of road
SRBL	side road bearing left
SRBR	side road bearing right
TISA	Traveller Information Services Association
TPEG	Transport Protocol Expert Group
TTI	traffic and travel information
UML	Unified Modelling Language
XML	eXtensible Markup Language

5 Toolkit specific constraints

5.1 Version number signalling

Version numbering is used to track the separate versions of a toolkit through its development and deployment. The differences between these versions may have an impact on client devices.

The version numbering principle is defined in ISO/TS 21219-1.

Table 1 shows the current version numbers for signalling the OLR version in use within this toolkit's top level component (see 7.1) and within TPEG-ML.

Table 1 — Current version number for signalling of OLR

Major version number	1
Minor version number	0

5.2 Extension

Future toolkit extensions may insert new components without losing backward compatibility. That means an OLR decoder shall be able to detect and skip unknown components.

6 OLR structure

6.1 Location types

6.1.1 Supported location types

OpenLR™ supports several types of locations. Table 2 lists the supported types and also provides a link to the clause where the specific type is explained in detail.

Table 2 — Supported location types

Name	Category	Details
Linear location	Linear location	See 6.1.2
Geo-Coordinate	Point location	See 6.1.3.2
PointAlongLine	Point location	See 6.1.3.3

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Table 2 *(continued)*

Name	Category	Details
PoiWithAccessPoint	Point location	See 6.1.3.4
Circle	Area location	See 6.1.4.2
Rectangle	Area location	See 6.1.4.3
Grid	Area location	See 6.1.4.4
Polygon	Area location	See 6.1.4.5
ClosedLinear	Area location	See 6.1.4.6

6.1.2 Linear locations

A linear location is a one-dimensional singular continuous path through a road network, from one start point location to one end point location. Offsets may be used to identify locations which do not start or end exactly at a network node.

NOTE Examples of linear locations are jams, (temporary) speed limits and (calculated) routes. Figure 1 and Figure 2 show different types of linear locations where the location is marked and the position of the offsets are shown as dots.

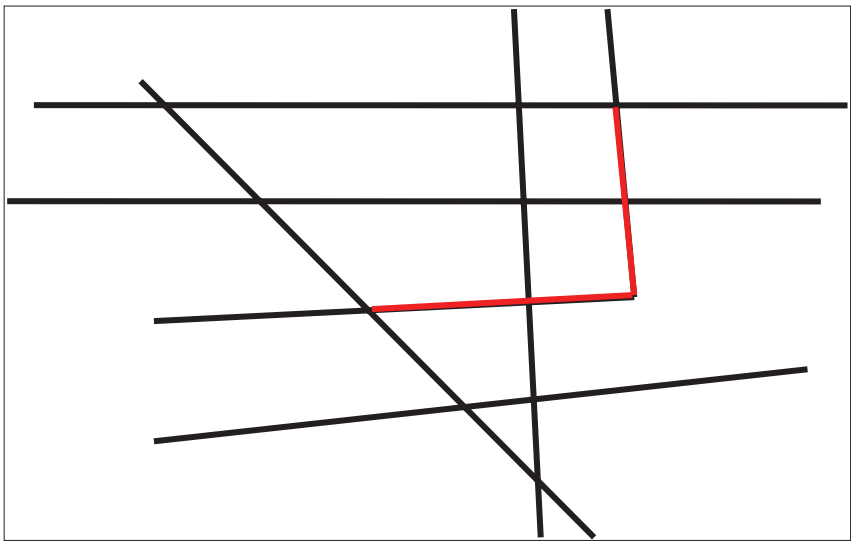

Figure 1 — Linear location without offsets

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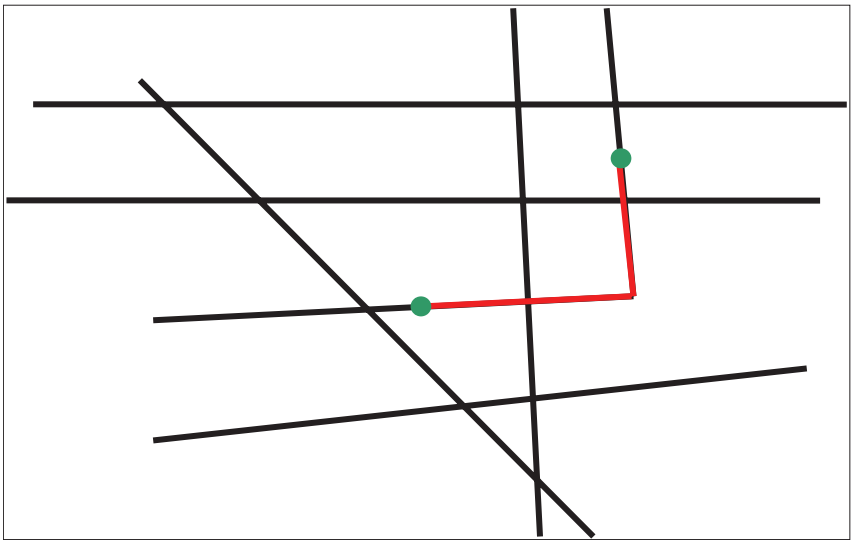

Figure 2 — Linear location with offsets

6.1.3 Point locations

6.1.3.1 General

A point location is a zero-dimensional element that specifies a spatial location by a coordinate pair. One coordinate pair specifies the point location. The following clauses outline different point location types when seen in combination with a (road) network and their real-world examples. The types differ in how the coordinate pair is related to the (road) network.

6.1.3.2 Geo-coordinate

A geo-coordinate pair is a position in a map defined by its longitude and latitude coordinate values. This type of point location may or may not be bound to the network and can be everywhere on the surface. Figure 3 shows an example of such a point location (filled circle).

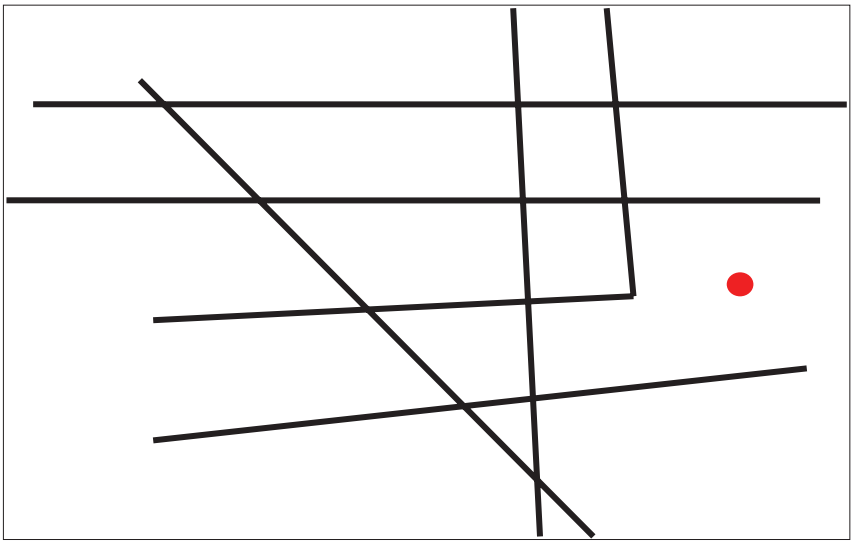

Figure 3 — Example — Geo-coordinate

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Real-world examples for a geo-coordinate as a point location are all coordinate pairs on the surface. This is the general type of a point location. All other types can also be expressed by only using the geo-coordinate pair.

6.1.3.3 Point along line

The next point location type is a location along a line. Such a line shall be bounded by two nodes. This point location is dependent on the road network and Figure 4 shows such an example (filled circle). The point may be on the right side of the line, on the left side of the line, on both sides of the line, or directly on the line. Additionally, the point may have an orientation to indicate in which direction of the line the information referenced at that point is useful.

Real-world examples of this point location type are points of interests closely or directly being related to the road network such as petrol stations, shopping malls and restaurants and also property locations and address points. But it can also be used to reference the location of speed cameras or induction loops.

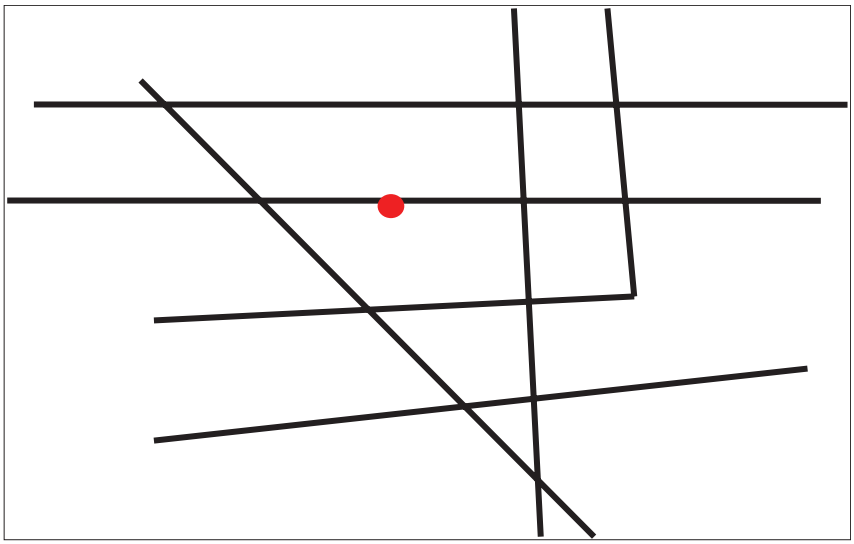

Figure 4 — Example — Point along line

6.1.3.4 Point of interest (POI) with access point (on a line)

Another point location type combines a point on a line with a geo-coordinate. The point on a line functions as an access point from the road network to a POI location represented by the geo-coordinate part. The access point may be on the right side of the line, on the left side of the line, on both sides of the line, or directly on the line. Additionally, the point may have an orientation to indicate in which direction of the line the information referenced at that point is useful.

Figure 5 shows an example of this point location type. The filled circle not related to the road network (coloured red in Figure 5) indicates the point location to be referenced. In combination with this point location, there is an access point (filled circle related to the road network) (coloured green in Figure 5). The access point identifies the location within the network used to access the point of interest. An application may use the network related point to navigate the user to the desired point location.

Examples for such point locations may be address points but also all point of interests (POI) not being closely related to the road network. Alternatively, the POI location may be used to reference other interesting locations such as access to petrol stations or parking garages.

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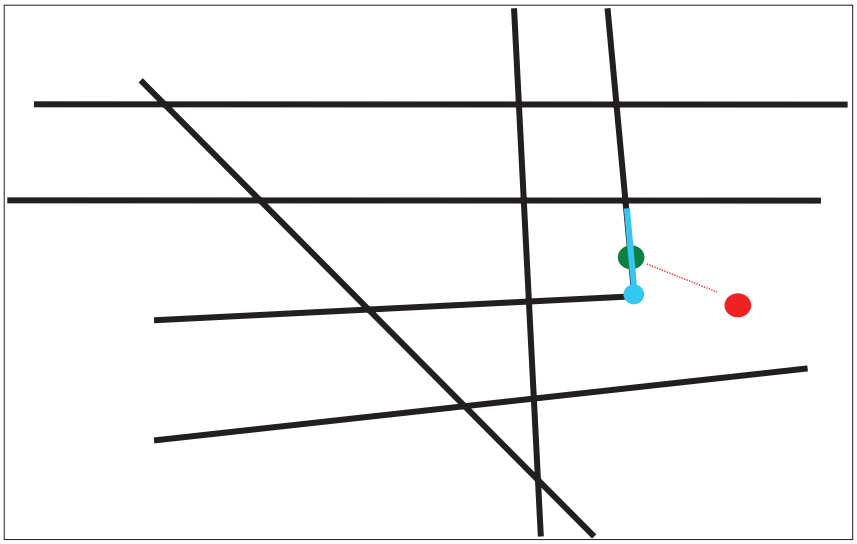

Figure 5 — Example — POI with access point

6.1.4 Area locations

6.1.4.1 General

An area location is a two-dimensional part of the surface of the earth which is bounded by a closed curve. An area location may cover parts of the road network but does not necessarily need to. Examples for area locations not covering the network are areas describing an area of woodland, a sea or agricultural land. In OpenLR™, area locations are defined by their boundary.

6.1.4.2 Circle

A circle location shall be given by the position of the centre and the radius. The centre position shall be a geo-coordinate pair of longitude and latitude coordinate values that may be everywhere on the surface. The radius shall be integer-valued and given in metres. Figure 6 shows an example of such an area location.

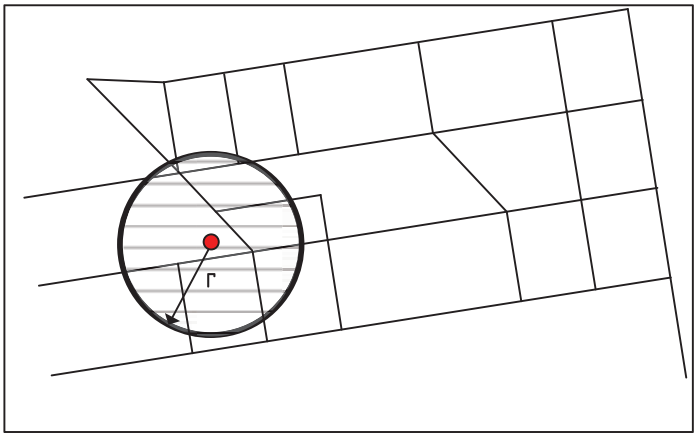

Figure 6 — Example — Circle

A real-world example for a circle location is a Wi-Fi hotspot with an approximation of its signal range.

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6.1.4.3 Rectangle

A rectangle location references to a rectangular shape. It shall be given by two geo-coordinate pairs which may be everywhere on the surface. The geo-coordinate pairs shall define the lower left (A) and the upper right (B) corner of the rectangular shape (see Figure 7).

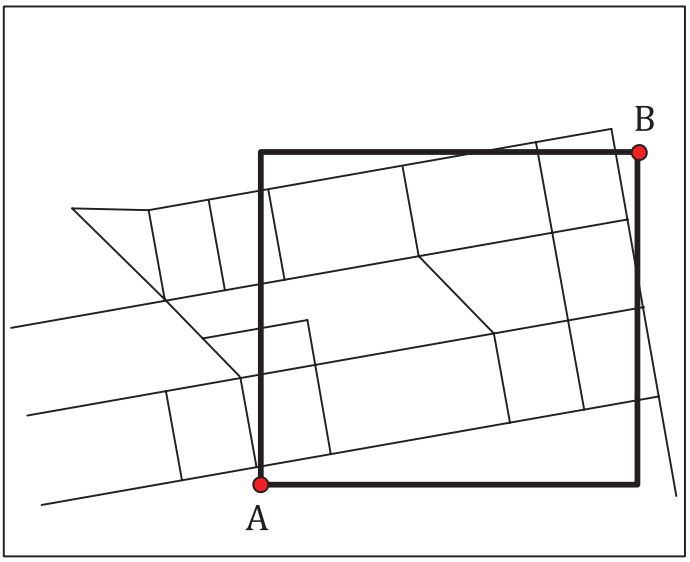

Figure 7 — Example — Rectangle location

Real-world examples are weather information or any area where the shape is not exactly specified and the location references shall be light-weighted.

6.1.4.4 Grid

A grid location is a special instance of a rectangle location. It shall be given by a base rectangular shape as described in 6.1.4.3. This base rectangle shall be the lower left cell of the grid and shall be multiplied to the north (by defining the number of rows) and to the East (by defining the number of columns). Figure 8 shows an example of such an area location.

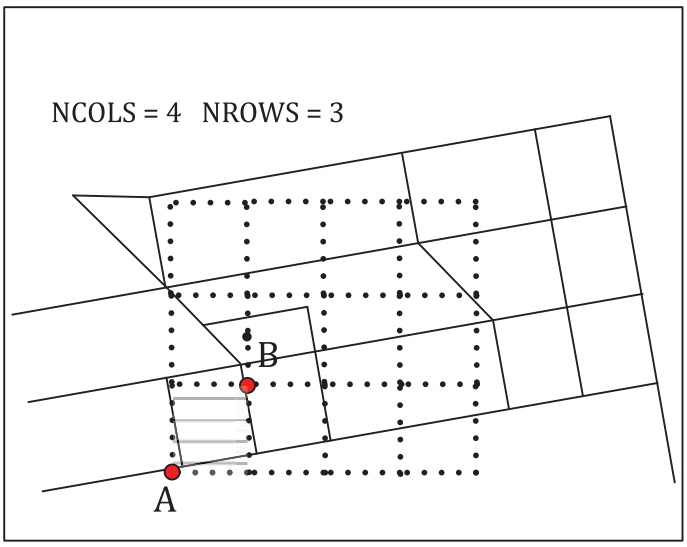

Figure 8 — Example — Grid location

Real-world examples are weather reports about, for example, average rainfall for every cell of the grid.

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6.1.4.5 Polygon

A polygon location is a non-intersecting shape defined by a sequence of geo-coordinate pairs. The coordinate pairs may be everywhere on the surface. They shall define the vertices of the underlying geometrical polygon. The boundary of this polygon shall be constituted by straight lines between every pair of consecutive geo-coordinates pairs in the sequence, plus the straight line between the last and the first geo-coordinate pairs. The order of the geo-coordinates pairs may be clockwise or counter-clockwise.

Figure 9 shows an example of such an area location, defined by the interior of the polygon.

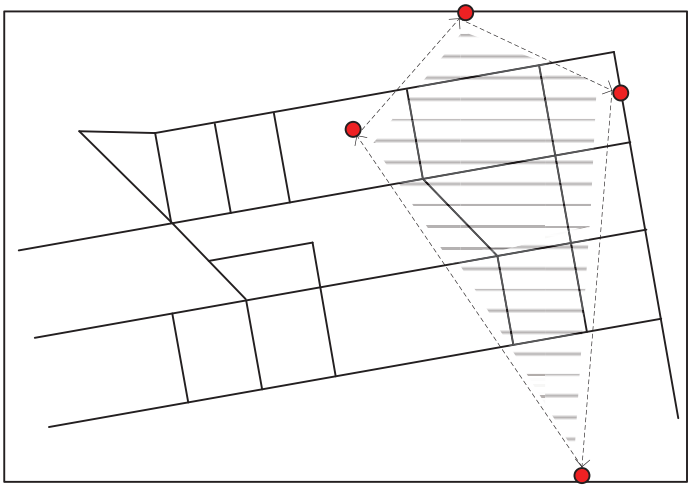

Figure 9 — Example — Polygon

Real-world examples for such area locations include low emission zones, areas affected by weather or environmental conditions (bad weather, smog), flood areas, areas that are congested (due to any cause, e.g. traffic overload, public event, or disaster), administrative areas, pedestrian areas, large crowds of people, areas that are blocked for traffic, and areas subject to city toll.

6.1.4.6 Closed linear location

A closed linear location references the area defined by a closed path (i.e. a circuit) in the road network. The boundary shall always consist of road segments. The path of a closed linear location may contain self-intersections if courses (e.g. marathon course) are referenced. Otherwise, for referencing areas, self-intersections should not appear. Figure 10 shows an example of such an area location.

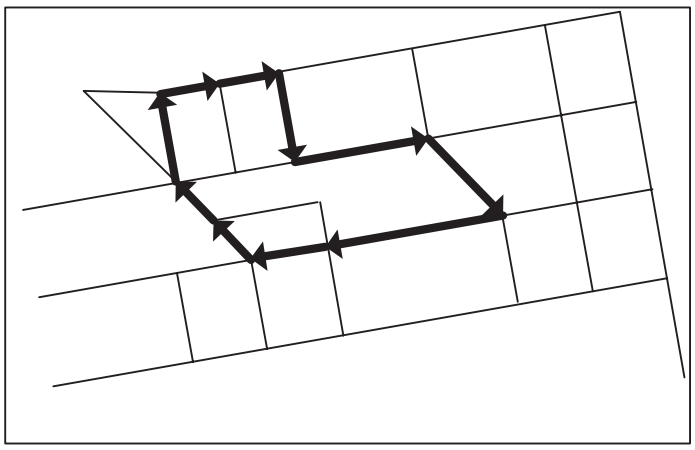

Figure 10 — Example — Closed linear location

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Real-world examples include low emission zones, congestion areas, areas that are blocked for traffic.

6.2 Requirements

6.2.1 General

The OpenLR™ approach focuses on creating map agnostic references for line, point and area locations. The digital map used for encoding and decoding and the location itself shall fulfil some requirements in order to guarantee acceptable results for the OpenLR™ method. Furthermore, the different location types may also define requirements in order to transmit meaningful locations.

6.2.2 Map requirements

A digital map consists of nodes and lines. Lines represent real-world roads or parts of a road. Nodes represent crossings of roads or parts of roads. Nodes are the connecting points between the lines.

The encoder and decoder map might differ but nevertheless, the OpenLR™ approach provides a method to reference to the same location represented in both maps.

To be able to generate a map-independent location reference and also able to resolve locations properly, a map should contain information about the following data:

- Coordinates in WGS84
  - Every node in the network should have coordinates in the WGS84 format.
  - The preferable accuracy is decamicrodegrees for each value.
- Length in metres
  - Every line should have a length value in metres indicating its real dimension along the geometry.
- Geometry
  - Every line should know about its real geometry in the real world.
  - Lines shall not be abstracted by the airline.
- Functional road class (FRC)
  - Every line in the network should have a functional road class value indicating its importance in the network.
- Form of way (FOW)
  - Every line in the network should have a form of way value indicating its physical properties.

If the coordinates are not in the WGS84 format, they shall be transformed into WGS84. The same applies if length values are not available in metres.

Different digital maps may have different classifications for the functional road class and the form of way values. It may also happen there exist more or less values. Therefore, OpenLR™ defines its own ranges for FRC and FOW. There shall be a mapping between the FRC values in the digital map and the FRC values as defined in the logical data format (see 6.3.2.3). The same applies for the FOW values (see 6.3.2.4). If no such functional road class values or form of way values are provided by the digital map data, then these shall be derived from other information available in the digital map.

If a digital map provides less information than required, the encoding and decoding processes do generally still succeed but the error rate can increase considerably. At least two out of the following three information types shall be available in the map data: geometry [for the calculation of bearing values (angle to the true north)], functional road class, form of way. The order geometry, FRC and FOW also indicate the importance of the information for a location reference point to be unique.

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6.2.3 Location properties

6.2.3.1 General

The location types may also define additional requirements in order to deal with a meaningful location. Locations which do not fulfil the location type requirements cannot be encoded with OpenLR™. The OpenLR™ encoder shall check each location if the requirements are met and shall report on any error.

6.2.3.2 Linear location

Linear locations shall fulfil the following requirements:

— A linear location shall be connected.

— Two subsequent lines in the location shall also be connected and adjacent in the underlying network. A linear location is represented by an ordered list of line elements.

  — The list of line elements shall be ordered from the start of a location to the end of a location.

— Offsets are always indicated by positive values and the total length of the offsets shall not exceed the length of the complete location.

6.2.3.3 Point locations

6.2.3.3.1 Geo-coordinate

Geo-coordinate locations do not have further requirements.

6.2.3.3.2 Point along line

Point along line locations shall fulfil the following requirements:

— The referenced line shall be a single line in the road network.

— The offset value defining the position of the location on the referenced line shall not exceed the length of the line.

6.2.3.3.3 POI with access point

POI with access point locations shall fulfil the following requirements:

— The referenced line shall be a single line in the road network.

— The offset value defining the position of the location on the referenced line shall not exceed the length of the line.

— The distance between the start node of the referenced line and the position of the POI shall not exceed the maximum distance between two location reference points as defined in Rule 1 in 6.4.

6.2.3.4 Area locations

6.2.3.4.1 General

Area locations should focus on simple (geometric) shapes. Mathematical operations like union or intersection of shapes are not supported and may be implemented by the application using OpenLR™ area locations.

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