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

Part 21: Geographic location referencing (TPEG-GLR)

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

Partie 21: Référencement d'emplacement géographique (TPEG2-GLR)

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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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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.

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 of 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.

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 (under development)], TPEG2-GLR (ISO/TS 21219-21), 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: SP10038/1.0/001.

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

Part 21: Geographic location referencing (TPEG-GLR)

1 Scope

This document defines a method of using geographic location referencing (GLR) that can be used by relevant TPEG applications. The GLR type is defined in this document. It is used for defining geographic location references (points, polylines, and geographical areas). The GLR method is intended to be one of the methods that can be transported inside a TPEG-location referencing container (TPEG-LRC) for those TPEG applications providing information for primarily geographical locations (e.g. weather).

The GLR specification is kept basic and compact on purpose, such that it can also be employed advantageously in non-navigation devices for simple TPEG services such as weather information, safety alerts, etc. As such, the GLR location referencing method is intended to be complementary to map-related location referencing methods, where the focus rather is on the referencing of man-made artefacts such as roads and highways.

The scope of GLR is limited to geographic locations on the Earth's surface for the above-mentioned rationale.

2 Normative references

There are no normative references in this document.

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
point of interest
specific point location that someone may find useful or interesting

Note 1 to entry: An example is a point on the Earth representing the location of the Eiffel Tower, in Paris, France, or a location of a weather station on top of Mount Washington in New Hampshire, VT, USA, or a location of a fuel station.

4 Abbreviated terms

ACID	Application and Content Identifier
ADC	Application Data Container
CEN	Comité Européen de Normalisation
EBU	European Broadcasting Union
GLR	Geographic Location Reference
LRC	Location Referencing Container
MMC	Message Management Container
OSI	Open Systems Interconnection
POI	Point Of Interest
SFW	TPEG Service Framework: Modelling and Conversion Rules
TISA	Traveller Information Services Association
TPEG	Transport Protocol Expert Group
TTI	Traffic and Travel Information
UML	Unified Modeling 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 GLR within TPEG-ML.

Table 1 — Current version numbers for signalling of GLR toolkit

major version number	2
minor version number	0

5.2 Extendibility

Future toolkit extensions may insert new components without losing backward compatibility. A GLR decoder shall be able to detect and skip unknown components.

6 GLR toolkit structure

6.1 General

The geographic location reference toolkit provides a component for simple geographic location references. This component can be inserted in a location referencing container inside a TPEG message, when this type of location reference is relevant and suitable for the particular TPEG application.

Figure 1 shows the structure of the GLR toolkit. The GLR location reference offers several variants of geographic location references. Each instance however shall contain only a single type of the provided various types of geographic location references.

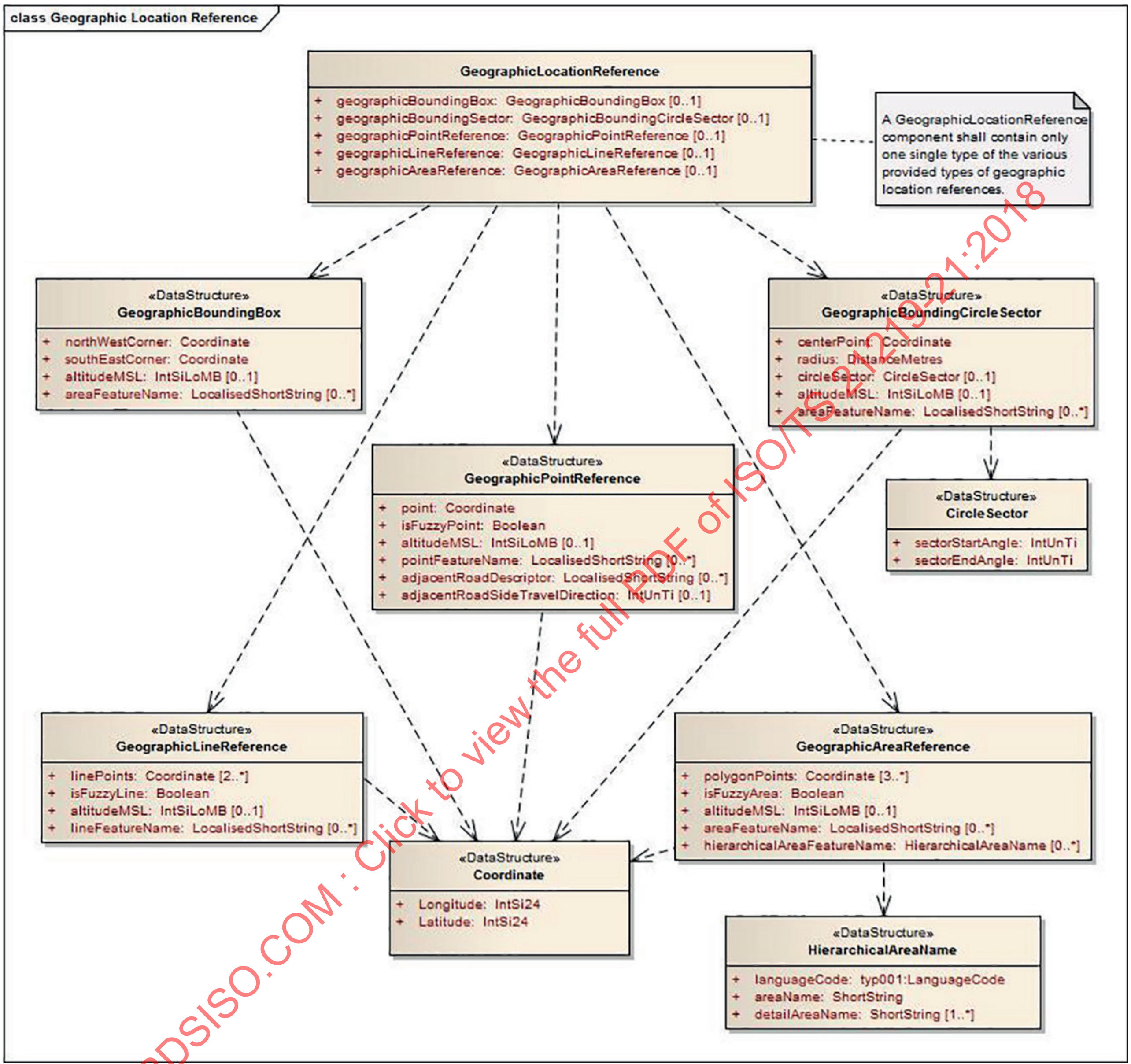

Figure 1 — Structure of the geographic location reference toolkit

In a GLR location reference, coordinates are specified in the WGS-84 geodetic system, unless explicitly signalled otherwise at service or service component level (see also 8.8).

The geographic location reference toolkit contains two versions of bounding areas, and point, line, and area location references. In the next subclauses, each of these variants of geographic location references is explained in more detail.

6.2 Geographic bounding box location reference

A geographic bounding box location reference defines a rectangular area to indicate, e.g. a search area or encompassing area of a collection of features, e.g. fuel stations or other POIs. Figure 2 shows a bounding box, with its defining north-west and south-east corners. For example, this bounding box location reference delineates the locations of a collection of fuel stations in Manhattan, NY, USA.

Figure 2 — Geographic bounding box indicating, e.g. a delineating search area for a set of fuel stations

Geographic bounding box location references may optionally indicate the altitude above mean sea level of the area, and optionally have an area name as descriptor.

6.3 Geographic bounding circle or sector of circle location reference

A geographic bounding circle location reference is very similar in nature as the geographic bounding box location reference. The chief difference is the definition of the encompassing area as, in this case, a circle rather than a rectangle. This circle is defined by a centre point and a radius (see Figure 3).

Figure 3 — Example of a geographic bounding circle location reference

Geographic bounding circle location references may optionally indicate the altitude above mean sea level of the area, and optionally have an area name as descriptor.

When a geographic bounding is to be limited to only a sector of a circle with a defined radius, this is specified through two azimuth angles. These angles specify the angular start and angular end of the sector (in clockwise direction) respectively. Both these angles are measured with respect to the geographic north (see Figure 4).

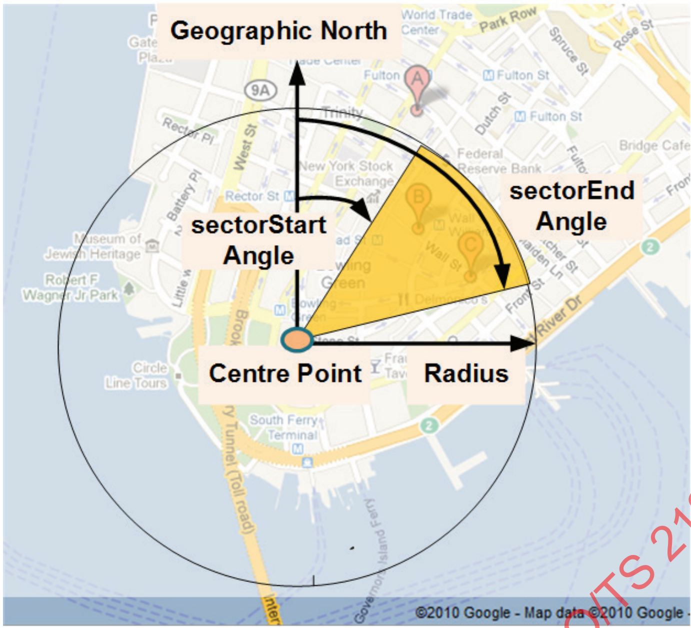

Figure 4 — Definition of a sector of a circle with sectorStartAngle and sectorEndAngle

6.4 Geographic point location reference

A geographic point location reference references the location of a point-type feature, e.g. a weather station, a theatre, or one of the individual fuel stations in Figures 2 and 3. If the location is approximate, e.g. the location of a highway intersection, the location reference can indicate this through an attribute "isFuzzyPoint" (see Figure 1).

Furthermore, for geographic location references of features close to roads, the road name of the adjacent road may optionally be indicated and optionally, the direction of travel on that road, leading to the primary entry point of that feature. Geographic point location references also may optionally indicate the altitude above mean sea level of the area, and optionally contain a point feature name as descriptor.

6.5 Geographic line location reference

A geographic line location reference references the location of a line-type feature, e.g. a squall line or the San Andreas Fault line in California, USA. If the location is approximate, e.g. the location of a squall line, the location reference can indicate this through an attribute "isFuzzyLine" (see Figure 1).

Geographic line location references also may optionally indicate the altitude above mean sea level of the area, and optionally have a line feature name as descriptor.

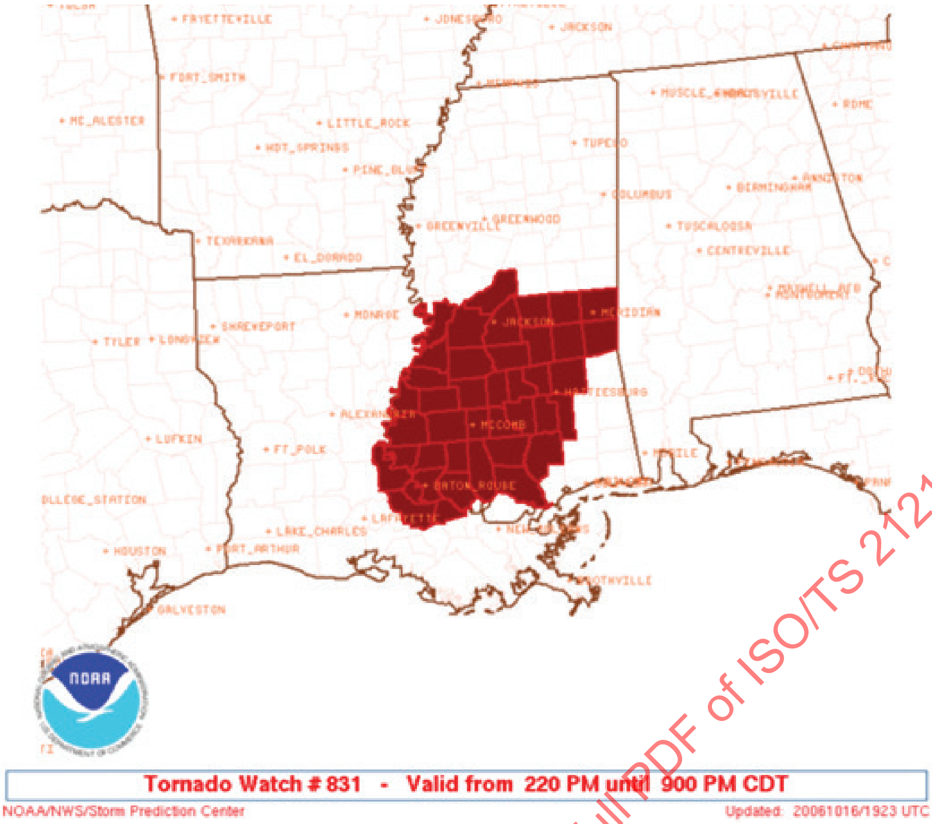

Figure 5 — Tornado watch location indication (source NOAA)

6.6 Geographic area location reference

A geographic area location reference references the location of an area-type feature, e.g. the location of a forest fire or a tornado warning. If the location is approximate, e.g. the location of a forest fire, the location reference can indicate this through an attribute “isFuzzyArea” (see Figure 1). Geographic area location references also may optionally indicate the altitude above mean sea level of the area.

Furthermore, geographic area location references may optionally include an area feature name as descriptor, or one or more hierarchical area names as descriptor. Hierarchical area names are for used in e.g. weather reporting for a tornado watch (see Figure 5).

For the example tornado watch shown in Figure 5, the hierarchal name descriptor is composed of two states, Louisiana and Mississippi, and for each of these two states the following parishes/counties, indicating the parts of that state for which the tornado watch is issued.

— **Louisiana**: Ascension, East Baton Rouge, East Feliciana, Iberville, Livingston, Pointe Coupee, St. Helena, St. Tammany, Tangipahoa, Washington, West Baton Rouge, West Feliciana

— **Mississippi**: Adams, Amite, Claiborne, Clarke, Copiah Covington, Forrest Franklin, Hinds, Jasper, Jefferson, Jefferson Davis, Jones, Lamar, Lauderdale, Lawrence, Lincoln, Madison, Marion, Newto, Pearl River, Pike, Rankin Scott, Simpson, Smith, Walthall, Warren, Wilkinson

In the geographic area location reference for this example tornado watch, these composite locations can be encoded with two HierarchicalAreaName data structures, one for each state.

7 GLR message components

7.1 GeographicLocationReference

Table 2 shows the geographic location reference: toolkit component for simple geographic location references. This component shall contain only one single type of the various provided types of geographic location references.

Table 2 — GeographicLocationReference

Name	Type	Multiplicity	Description
geographicBoundingBox	GeographicBoundingBox	0..1	BoundingBox-type geographic location reference.
geographicBoundingSector	GeographicBoundingCircleSector	0..1	Bounding area geographic location reference as sector of a circle or complete circle.
geographicPointReference	GeographicPointReference	0..1	Point-type geographic location reference.
geographicLineReference	GeographicLineReference	0..1	Line-type geographic location reference.
geographicAreaReference	GeographicAreaReference	0..1	Area-type geographic location reference.

8 GLR datatypes

8.1 CircleSector

Table 3 shows the data structure to specify the relevant sector of the circle.

Table 3 — CircleSector

Name	Type	Multiplicity	Description
sectorStartAngle	IntUnTi	1	Azimuth angle to start of circle sector of interest. The sectorStartAngle is measured clockwise from geographic north, expressed in units of 360/256 degrees.
sectorEndAngle	IntUnTi	1	Azimuth angle to end of circle sector of interest. The sectorEndAngle is measured clockwise from geographic north, expressed in units of 360/256 degrees.

8.2 GeographicAreaReference

Table 4 shows the geographic area specified as a polygon.

A GeographicAreaReference shall include at most one of the attributes "areaFeatureName" and "hierarchicalAreaFeatureName", but not both.

Table 4 — GeographicAreaReference

Name	Type	Multiplicity	Description
polygonPoints	Coordinate	3..*	A sequence of points forming a closed, simple (i.e. non-self intersecting) contour of a geographic polygon. The polygon contour is formed by line segments connecting the successive points, and finally the polygon contour is closed by the line segment connecting the last point to the first point. The resulting area polygon shall be non-self intersecting. Recommended is to limit the number of points of the polygon to 32 or less.
isFuzzyArea	Boolean	1	If set, the "isFuzzyArea" attribute indicates that the polygon shape represents a fuzzy area, i.e. the polygon shape is an approximate description of the location of the referenced feature.
altitudeMSL	IntSiLoMB	0..1	Average elevation of location in metres above/below mean sea level (MSL).
areaFeatureName	LocalisedShortString	0..*	Feature name of the area reference in the local languages of interest.
hierarchicalAreaFeatureName	HierarchicalAreaName	0..*	Attribute to express area name(s) as hierarchical feature name. Several hierarchical area names are allowed to express, e.g. a region of a number of countries, or a number of states. Each such hierarchical area name structure indicates the local language of interest. Multiple hierarchical area names in a single local language may be supplied.

8.3 GeographicBoundingBox

Table 5 shows the geographic area defined as a bounding box. A bounding box area is an approximate geometric description completely encompassing the actual location of an area or a collection of point locations intended to be referenced.

Table 5 — GeographicBoundingBox

Name	Type	Multiplicity	Description
northWestCorner	Coordinate	1	Coordinate of the North West Corner of the bounding box enclosing the area.
southEastCorner	Coordinate	1	Coordinate of the South East Corner of the bounding box enclosing the area.
altitudeMSL	IntSiLoMB	0..1	Average elevation of location in metres above/below mean sea level (MSL).
areaFeatureName	LocalisedShortString	0..*	(Optional) Feature name of the area in the local languages of interest.

8.4 GeographicBoundingCircleSector

Table 6 shows the geographic bounding area defined as a complete circle or a sector of a circle.

A bounding circle (or sector of a circle) area is an approximate geometric description completing and encompassing the actual location of an area location or a collection of point locations intended to be referenced.

Table 6 — GeographicBoundingCircleSector

Name	Type	Multiplicity	Description
centerPoint	Coordinate	1	Coordinate of centre point of the bounding circle enclosing the area.
radius	DistanceMetres	1	Radius of the bounding circle enclosing the area.
circleSector	CircleSector	0..1	Optional attribute to limit bounding area to only a sector of the complete circle. If this attribute is not present, the bounding area shall be taken as the complete circle.
altitudeMSL	IntSiLoMB	0..1	Average elevation of location in metres above/below mean sea level (MSL).
areaFeatureName	LocalisedShortString	0..*	(Optional) Feature name of the area in the local languages of interest.

8.5 GeographicLineReference

Table 7 shows the geographic line as defined by a polyline.

Table 7 — GeographicLineReference

Name	Type	Multiplicity	Description
linePoints	Coordinate	2..*	A sequence of points forming a line. The polyline shape is formed by line segments connecting the successive points from the first point to the last point. The resulting polyline shall be non-self intersecting. Recommended is to limit the number of points of the polyline to 32 or less.
isFuzzyLine	Boolean	1	If set, the "isFuzzyLine" attribute indicates that the polyline shape represents a fuzzy line, i.e. the polyline is an approximate description of the location of the referenced feature.
altitudeMSL	IntSiLoMB	0..1	Average elevation of location in metres above/below Mean Sea Level (MSL)
lineFeatureName	LocalisedShortString	0..*	(Optional) Feature name of the referenced line location in the local languages of interest.

8.6 GeographicPointReference

Table 8 shows the point-type geographic location reference.

Table 8 — GeographicPointReference

Name	Type	Multiplicity	Description
point	Coordinate	1	(Centre) Coordinate of the point location reference.
isFuzzyPoint	Boolean	1	If set, the "isFuzzyPoint" attribute indicates that the supplied coordinate represents an approximate location only.
altitudeMSL	IntSiLoMB	0..1	Elevation of location in metres above/below mean sea level (MSL).
pointFeatureName	LocalisedShortString	0..*	(Optional) Feature name of the referenced point location in the local languages of interest.
adjacentRoadDescriptor	LocalisedShortString	0..*	(Optional, if it exists) Name and/or road number of the road adjacent to the location in the local languages of interest.
adjacentRoadSideTravelDirection	IntUnTi	0..1	(Optional) Approximate direction of travel for the closest side of the adjacent road (if it exists) at which the point location is located. The adjacentRoadSideTravelDirection is an azimuth angle. It is measured clockwise from the geographic north, and expressed in units of 360/256 degrees.

8.7 HierarchicalAreaName

Table 9 shows the data structure used to specify an area as a collection of smaller areas as part of a larger area. Typical usage would be to specify a province or state as the larger administrative area, and the counties as the smaller administrative areas.

The supplied languageCode indicates the local language for both the areaName as the detailedAreaNames supplied.

In certain applications, e.g. weather alerts, affected areas may be specified as such hierarchical areas.

Table 9 — HierarchicalAreaName

Name	Type	Multiplicity	Description
languageCode	typ001:LanguageCode	1	Specifies the local language used for the names making up the hierarchical area name.
areaName	ShortString	1	Overall feature name of the area reference.
detailAreaName	ShortString	1..*	One or more detail area name(s) of the area reference.

8.8 Coordinate

Table 10 shows the data-structure for specifying geographic coordinates. Coordinates are specified by default in the WGS-84 geodetic system, unless explicitly signalled otherwise at service, or service component level.

Table 10 — Coordinate

Name	Type	Multiplicity	Description
Longitude	IntSi24	1	Longitude in standard 24-bit accuracy stores coordinates in order of magnitude of 10 micro degrees resolution (five decimals). Longitude-in-degrees (longitude in unit degrees) is encoded as follows: longitude = int {sign[longitude-in-degrees] × 0,5 + [longitude-in-degrees × (2^{24})]/360}
Latitude	IntSi24	1	Latitude in standard 24 bit accuracy stores coordinates in order of magnitude of 10 microdegrees resolution (five decimals). Latitude-in-degrees (latitude in unit degrees) is encoded as follows: latitude = int {sign[latitude-in-degrees]*0,5 + [latitude-in-degrees × (2^{24})]/360}

9 GLR Tables

This version of the GLR technical specification does not include any tables.

Annex A
(normative)

Geographic location reference, TPEG-binary representation

A.1 General

In this annex, the TPEG-Binary representation is specified.

A.2 Message components

A.2.1 List of generic component ids

This version of the GLR specification does not assign component IDs. As GLR is a toolkit the top-level component gets its ID assigned in the location referencing container (ISO/TS 21219-7) as shown in Table A.1.

Table A.1 — Generic component ids

Name	Id
GeographicLocationReference	defined by LRC

A.2.2 GeographicLocationReference

<GeographicLocationReference(x)>:=	
<**IntUnTi**>(x),	: id of this component
<**IntUnLoMB**>(lengthComp),	: number of bytes in component
<**IntUnLoMB**>(lengthAttr),	: number of bytes in attributes
<**BitArray**>(selector),	
if (bit 0 of selector is set)	
<**GeographicBoundingBox**>(geographicBoundingBox),	: BoundingBox-type geographic location reference.
if (bit 1 of selector is set)	
<**GeographicBoundingCircleSector**>(geographicBounding-Sector),	: Bounding area geographic location reference as sector of a circle or complete circle.
if (bit 2 of selector is set)	
< **GeographicPointReference**>(geographicPointRefer-ence),	: Point-type geographic location reference.
if (bit 3 of selector is set)	
<**GeographicLineReference**>(geographicLineReference),	: Line-type geographic location reference.
if (bit 4 of selector is set)	
<**GeographicAreaReference**>(geographicAreaReference);	: Area-type geographic location reference.

A.3 GLR datatypes

A.3.1 CircleSector

<CircleSector()>:=	
<**IntUnTi**>(sectorStartAngle),	: Azimuth angle to start of circle sector of interest. The sectorStartAngle is measured clockwise from the geographic north, expressed in units of 360/256 degrees.
<**IntUnTi**>(sectorEndAngle);	: Azimuth angle to end of circle sector of interest. The sectorEndAngle is measured clockwise from the geographic north, expressed in units of 360/256 degrees.

A.3.2 GeographicAreaReference

<GeographicAreaReference()>:=	
<**IntUnLoMB**>(n),	
n *<**Coordinate**>(polygonPoints),	: A sequence of points forming a closed, simple (i.e. non-self intersecting) contour of a geographic polygon. The polygon contour is formed by line segments connecting the successive points, and finally the polygon contour is closed by the line segment connecting the last point to the first point. The resulting area polygon shall be non-self intersecting. Recommended is to limit the number of points of the polygon to 32 or less.
<**BitArray**>(selector),	
if (bit 0 of selector is set)	
<**Boolean**>(isFuzzyArea),	: If set, the "isFuzzyArea" attribute indicates that the polygon shape represents a fuzzy area, i.e. the polygon shape is an approximate description of the location of the referenced feature.
if (bit 1 of selector is set)	
<**IntSiLoMB**>(altitudeMSL),	: Average elevation of location in metres above/below mean sea level (MSL).
if (bit 2 of selector is set)	
{	
<**IntUnLoMB**>(n),	
n *<**LocalisedShortString**>(areaFeatureName),	: Feature name of the area reference in the local languages of interest.
}	
if (bit 3 of selector is set)	
{	

< **IntUnLoMB**>(n),	
n * <**HierarchicalAreaName**>(hierarchicalAreaFeatureName);	: Attribute to express area name(s) as hierarchical feature name. Several hierarchical area names are allowed to express e.g. a region of a number of countries, or a number of states. Each such a hierarchical area name structure indicates the local language of interest. Multiple hierarchical area names in a single local language may be supplied.
}	

A.3.3 GeographicBoundingBox

<GeographicBoundingBox()>:=	
<**Coordinate**>(northWestCorner),	: Co-ordinate of the North West Corner of the bounding box enclosing the area.
<**Coordinate**>(southEastCorner),	: Co-ordinate of the South East Corner of the bounding box enclosing the area.
<**BitArray**>(selector),	
if (bit 0 of selector is set)	
<**IntSiLoMB**>(altitudeMSL),	: Average elevation of location in metres above/below Mean Sea Level (MSL).
if (bit 1 of selector is set)	
{	
< **IntUnLoMB**>(n),	
n * <**LocalisedShortString**>(areaFeatureName);	: (optional) Feature name of the area in the local languages of interest.
}	

A.3.4 GeographicBoundingCircleSector

<GeographicBoundingCircleSector()>:=	
<**Coordinate**>(centerPoint),	: Co-ordinate of centre point of the bounding circle enclosing the area.
<**DistanceMetres**>(radius),	: Radius of the bounding circle enclosing the area.
<**BitArray**>(selector),	
if (bit 0 of selector is set)	
<**CircleSector**>(circleSector),	: Optional attribute to limit bounding area to only a sector of the complete circle If this attribute is not present, the bounding area shall be taken as the complete circle.
if (bit 1 of selector is set)	
<**IntSiLoMB**>(altitudeMSL),	: Average elevation of location in metres above/below mean sea level (MSL).
if (bit 2 of selector is set)	
{	

<**IntUnLoMB**>(n),	
n * <**LocalisedShortString**>(areaFeatureName);	: (optional) Feature name of the area in the local languages of interest.
}	

A.3.5 Geographic Line Reference

<GeographicLineReference()>:=	
<**IntUnLoMB**>(n),	
n *<**Coordinate**>(linePoints),	: A sequence of points forming a line. The polyline shape is formed by line segments connecting the successive points from the first point to the last point. The resulting polyline shall be non-self intersecting. Recommended is to limit the number of points of the polyline to 32 or less.
<**BitArray**>(selector),	
if (bit 0 of selector is set)	
<**Boolean**>(isFuzzyLine),	: If set, the “isFuzzyLine” attribute indicates that the polyline shape represents a fuzzy line, i.e. the polyline is an approximate description of the location of the referenced feature.
if (bit 1 of selector is set)	
<**IntSiLoMB**>(altitudeMSL),	: Average elevation of location in metres above/below Mean Sea Level (MSL)
if (bit 2 of selector is set)	
{	
<**IntUnLoMB**>(n),	
n * <**LocalisedShortString**>(lineFeatureName);	: (optional) Feature name of the referenced line location in the local languages of interest.
}	

A.3.6 GeographicPointReference

<GeographicPointReference()>:=	
<**Coordinate**>(point),	: (centre) Co-ordinate of the point location reference.
<**BitArray**>(selector),	
if (bit 0 of selector is set)	
<**Boolean**>(isFuzzyPoint),	: If set, the “isFuzzyPoint” attribute indicates that the supplied coordinate represents an approximate location only.
if (bit 1 of selector is set)	
<**IntSiLoMB**>(altitudeMSL),	: Elevation of location in metres above/below Mean Sea Level (MSL).
if (bit 2 of selector is set)	
{	

<**IntUnLoMB**>(n),	
n * <**LocalisedShortString**>(pointFeatureName),	: (optional) Feature name of the referenced point location in the local languages of interest.
}	
if (bit 3 of selector is set)	
{	
<**IntUnLoMB** >(n),	
n * <**LocalisedShortString**>(adjacentRoadDescriptor),	: (optional, if it exists) Name and/or road number of the road adjacent to the location in the local languages of interest.
}	
if (bit 4 of selector is set)	
<**IntUnTi**>(adjacentRoadSideTravelDirection);	: (optional) Approximate direction of travel for the closest side of the adjacent road (if it exists) at which the point location is located. The adjacentRoadSideTravelDirection is an azimuth angle. It is measured clockwise from the Geographic North, and expressed in units of 360/256 degrees.

A.3.7 HierarchicalAreaName

<HierarchicalAreaName()>:=	
<**typ001:LanguageCode**>(languageCode),	: Specifies the local language used for the names making up the hierarchical area name.
<**ShortString**>(areaName),	: Overall feature name of the area reference.
<**IntUnLoMB**>(n),	
n *< **ShortString**>(detailAreaName);	:One or more detail area name(s) of the area reference.

A.3.8 Coordinate

<Coordinate()>:=	
<**IntSi24**>(Longitude),	:Longitude in standard 24-bit accuracy stores coordinates in order of magnitude of 10 microdegrees resolution (five decimals). Longitude-in-degrees (longitude in unit degrees) is encoded as follows: longitude = int {sign[longitude-in-degrees] × 0,5 + [longitude-in-degrees × (2^{24})]/360}
<**IntSi24**>(Latitude);	:Latitude in standard 24-bit accuracy stores coordinates in order of magnitude of 10 microdegrees resolution (five decimals). Latitude-in-degrees (latitude in unit degrees) is encoded as follows: latitude = int {sign[longitude-in-degrees] × 0,5 + [longitude-in-degrees × (2^{24})]/360}

Annex B
(normative)

Geographic location reference, TPEG-ML representation

B.1 General

In this annex, the TPEG-ML representation is specified.

B.2 Message Components

B.2.1 XSD Schema Framing

XSD Schema Framing is specified in the TPEG Service Framework in ISO/TS 21219-5.

B.2.2 GeographicLocationReference

```
<xs:complexType name="GeographicLocationReference">
<xs:sequence>
<xs:element name="geographicBoundingBox" type="GeographicBoundingBox"
minOccurs="0" />
<xs:element name="geographicBoundingSector" type="GeographicBoundingCircl
eSector" minOccurs="0" />
<xs:element name="geographicPointReference"
type="GeographicPointReference" minOccurs="0" />
<xs:element name="geographicLineReference" type="GeographicLineReference"
minOccurs="0" />
<xs:element name="geographicAreaReference" type="GeographicAreaReference"
minOccurs="0" />
</xs:sequence>
</xs:complexType>
```


B.3 Datatypes

B.3.1 CircleSector

```
<xs:complexType name="CircleSector">
<xs:sequence>
<xs:element name="sectorStartAngle" type="tdt:IntUnTi" />
<xs:element name="sectorEndAngle" type="tdt:IntUnTi" />
</xs:sequence>
</xs:complexType>
```

B.3.2 GeographicAreaReference

```
<xs:complexType name="GeographicAreaReference">
<xs:sequence>
<xs:element name="polygonPoints" type="Coordinate" minOccurs="3"
maxOccurs="unbounded" />
<xs:element name="isFuzzyArea" type="tdt:Boolean" />
<xs:element name="altitudeMSL" type="tdt:IntSiLoMB" minOccurs="0" />
<xs:element name="areaFeatureName" type="tdt:LocalisedShortString"
minOccurs="0" maxOccurs="unbounded" />
<xs:element name="hierarchicalAreaFeatureName"
type="HierarchicalAreaName" minOccurs="0" maxOccurs="unbounded" />
</xs:sequence>
</xs:complexType>
```

B.3.3 GeographicBoundingBox

```
<xs:complexType name="GeographicBoundingBox">
<xs:sequence>
<xs:element name="northWestCorner" type="Coordinate" />
<xs:element name="southEastCorner" type="Coordinate" />
<xs:element name="altitudeMSL" type="tdt:IntSiLoMB" minOccurs="0" />
<xs:element name="areaFeatureName" type="tdt:LocalisedShortString"
minOccurs="0" maxOccurs="unbounded" />
</xs:sequence>
</xs:complexType>
```

B.3.4 GeographicBoundingCircleSector

```
<xs:complexType name="GeographicBoundingCircleSector">
<xs:sequence>
<xs:element name="centerPoint" type="Coordinate" />
<xs:element name="radius" type="tdt:DistanceMetres" />
<xs:element name="circleSector" type="CircleSector" minOccurs="0" />
<xs:element name="altitudeMSL" type="tdt:IntSiLoMB" minOccurs="0" />
<xs:element name="areaFeatureName" type="tdt:LocalisedShortString"
minOccurs="0" maxOccurs="unbounded" />
</xs:sequence>
</xs:complexType>
```


B.3.5 GeographicLineReference

```
<xs:complexType name="GeographicLineReference">
<xs:sequence>
<xs:element name="linePoints" type="Coordinate" minOccurs="2"
maxOccurs="unbounded" />
<xs:element name="isFuzzyLine" type="tdt:Boolean" />
<xs:element name="altitudeMSL" type="tdt:IntSiLoMB" minOccurs="0" />
<xs:element name="lineFeatureName" type="tdt:LocalisedShortString"
minOccurs="0" maxOccurs="unbounded" />
</xs:sequence>
</xs:complexType>
```

B.3.6 GeographicPointReference

```
<xs:complexType name="GeographicPointReference">
<xs:sequence>
<xs:element name="point" type="Coordinate" />
<xs:element name="isFuzzyPoint" type="tdt:Boolean" />
<xs:element name="altitudeMSL" type="tdt:IntSiLoMB" minOccurs="0" />
<xs:element name="pointFeatureName" type="tdt:LocalisedShortString"
minOccurs="0" maxOccurs="unbounded" />
<xs:element name="adjacentRoadDescriptor" type="tdt:LocalisedShortString"
minOccurs="0" maxOccurs="unbounded" />
<xs:element name="adjacentRoadSideTravelDirection" type="tdt:IntUnTi"
minOccurs="0" />
</xs:sequence>
</xs:complexType>
```

B.3.7 HierarchicalAreaName

```
<xs:complexType name="HierarchicalAreaName">
<xs:sequence>
<xs:element name="languageCode" type="tdt:typ001_LanguageCode" />
<xs:element name="areaName" type="tdt:ShortString" />
<xs:element name="detailAreaName" type="tdt:ShortString"
maxOccurs="unbounded" />
</xs:sequence>
</xs:complexType>
```

B.3.8 Coordinate

```
<xs:complexType name="Coordinate">
<xs:sequence>
<xs:element name="Longitude" type="tdt:IntSi24" />
<xs:element name="Latitude" type="tdt:IntSi24" />
</xs:sequence>
</xs:complexType>
```

B.4 Full GLR schema definition

```
<?xml version="1.0" encoding="UTF-8"?>
<xs:schema xmlns="http://www.tisa.org/TPEG/GLR_2_0"
     targetNamespace="http://www.tisa.org/TPEG/GLR_2_0"
     xmlns:xs="http://www.w3.org/2001/XMLSchema"
     xmlns:tdt="http://www.tisa.org/TPEG/TPEGDataTypes_2_0"
     elementFormDefault="qualified"
     attributeFormDefault="qualified">
<xs:import namespace="http://www.tisa.org/TPEG/TPEGDataTypes_2_0"
schemaLocation="TDT_2_0.xsd"/>

<xs:complexType name="GeographicLocationReference">
<xs:sequence>
<xs:element name="geographicBoundingBox" type="GeographicBoundingBox"
minOccurs="0" />
<xs:element name="geographicBoundingSector" type="GeographicBoundingCircl
eSector" minOccurs="0" />
<xs:element name="geographicPointReference"
type="GeographicPointReference" minOccurs="0" />
<xs:element name="geographicLineReference" type="GeographicLineReference"
minOccurs="0" />
<xs:element name="geographicAreaReference" type="GeographicAreaReference"
minOccurs="0" />
</xs:sequence>
</xs:complexType>

<xs:complexType name="CircleSector">
<xs:sequence>
<xs:element name="sectorStartAngle" type="tdt:IntUnTi" />
<xs:element name="sectorEndAngle" type="tdt:IntUnTi" />
</xs:sequence>
</xs:complexType>
```