

BS ISO 17572-3:2015



BSI Standards Publication

# Intelligent transport systems (ITS) — Location referencing for geographic databases

Part 3: Dynamic location references  
(dynamic profile)

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**National foreword**

This British Standard is the UK implementation of ISO 17572-3:2015. It supersedes BS ISO 17572-3:2008 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee EPL/278, Intelligent transport systems.

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**Intelligent transport systems (ITS) —  
Location referencing for geographic  
databases —**

**Part 3:  
Dynamic location references  
(dynamic profile)**

*Systèmes intelligents de transport (SIT) — Localisation pour bases de  
données géographiques —*

*Partie 3: Localisations dynamiques (profil dynamique)*





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## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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](http://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](http://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 meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT), see the following URL: [Foreword — Supplementary information](#).

The committee responsible for this document is ISO/TC 204, *Intelligent transport systems*.

This second edition cancels and replaces the first edition (ISO 17572-3:2008), which has been technically revised. It also incorporates Technical Corrigendum ISO 17572-3:2008/Cor1:2009.

ISO 17572 consists of the following parts, under the general title *Intelligent transport systems (ITS) — Location referencing for geographic databases*:

- *Part 1: General requirements and conceptual model*
- *Part 2: Pre-coded location references (pre-coded profile)*
- *Part 3: Dynamic location references (dynamic profile)*

## Introduction

A location reference (LR) is a unique identification of a geographic object. In a digital world, a real-world geographic object can be represented by a feature in a geographic database. An example of a commonly known location reference is a postal address of a house. Examples of object instances include a particular exit ramp on a particular motorway, a road junction, or a hotel. For efficiency reasons, location references are often coded. This is especially significant if the location reference is used to define the location for information about various objects between different systems. For intelligent transport systems (ITS), many different types of real-world objects will be addressed. Amongst these, location referencing of the road network, or components thereof, is a particular focus.

Communication of a location reference for specific geographic phenomena, corresponding to objects in geographic databases, in a standard, unambiguous manner is a vital part of an integrated ITS system, in which different applications and sources of geographic data will be used. Location referencing methods (LRMs, methods of referencing object instances) differ by applications, by the data model used to create the database, or by the enforced object referencing imposed by the specific mapping system used to create and store the database. A standard location referencing method allows for a common and unambiguous identification of object instances representing the same geographic phenomena in different geographic databases produced by different vendors, for varied applications, and operating on multiple hardware/software platforms. If ITS applications using digital map databases are to become widespread, data reference across various applications and systems has to be possible. Information prepared on one system, such as traffic messages, has to be interpretable by all receiving systems. A standard method to refer to specific object instances is essential to achieving such objectives.

Japan, Korea, Australia, Canada, the US, and European ITS bodies are all supporting activities of location referencing. Japan has developed a Link Specification for VICS. In Europe, the RDS-TMC traffic messaging system has been developed. In addition, methods have been developed and refined in the EVIDENCE and AGORA projects based on intersections identified by geographic coordinates and other intersection descriptors. After the publication of the first edition of this International Standard in 2008, TPEG had changed to TPEG2. Modifications related to this change are captured in this second edition. In the US, standards for location referencing have been developed to accommodate several different location referencing methods.

This International Standard provides specifications for location referencing for ITS systems (although other committees or standardization bodies can subsequently consider extending it to a more generic context). In addition, this version does not deal with public transport location referencing; this issue will be dealt with in a later version.

The International Organization for Standardization (ISO) draws attention to the fact that it is claimed that compliance with this part of ISO 17572 can involve the use of a patent concerning procedures, methods and/or formats given in this part of ISO 17572 in [Clauses 8](#) and [9](#) and [Annexes A](#), [B](#), and [C](#).

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Japan

Blaupunkt GmbH

Robert-Bosch-Str. 200, 31139 Hildesheim, Germany

Siemens AG

Philipstr. 1, 35576 Wetzlar, Germany

Tele Atlas NV

Reitscheweg 7F, 5232 BX 's-Hertogenbosch, Netherlands

Toyota Motor Co. (et al.)

1 Toyota-Cho, Toyota City, Aichi Prefecture 471-8571, Japan



# Intelligent transport systems (ITS) — Location referencing for geographic databases —

## Part 3: Dynamic location references (dynamic profile)

### 1 Scope

This International Standard specifies location referencing methods (LRMs) that describe locations in the context of geographic databases and will be used to locate transport-related phenomena in an encoder system as well as in the decoder side. This International Standard defines what is meant by such objects and describes the reference in detail, including whether or not components of the reference are mandatory or optional, and their characteristics.

This International Standard specifies two different LRMs:

- pre-coded location references (pre-coded profile);
- dynamic location references (dynamic profile).

This International Standard does not define a physical format for implementing the LRM. However, the requirements for physical formats are defined.

This International Standard does not define details of the location referencing system (LRS), i.e. how the LRMs are to be implemented in software, hardware, or processes.

This part of ISO 17572 specifies the dynamic location referencing method, comprising

- attributes and encoding rules
- logical data modelling
- TPEG physical format specification for dynamic location references,
- coding guidelines for dynamic location references;
- compressed data format specification.

It is consistent with other International Standards developed by ISO/TC 204 such as ISO 14825.

### 2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 17572-1, *Intelligent transport systems (ITS) — Location referencing for geographic databases — Part 1: General requirements and conceptual model*

### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 17572-1 and the following apply.

**3.1**  
**bearing**

angle between a reference direction and the direction to an object measured clockwise

Note 1 to entry: Unless otherwise specified, the reference direction is generally understood to be geographic north.

**3.2**  
**connection angle**

**CA**  
difference between *side road bearing* (3.23) and *bearing* (3.1) at a point

**3.3**  
**connection point**

location point captured in the location reference core, which forms the start point of a path external to the location

Note 1 to entry: Connection points are used to connect a location reference extension to a location reference core and to connect linear locations to form a subnetwork. The connection point is identified using its connection point index.

Note 2 to entry: The connection point index is implicitly defined by the order of the points in a location reference.

**3.4**  
**connectivity**  
status of being topologically connected

Note 1 to entry: In a graph, two or more edges are said to be connected if they share one or more nodes.

**3.5**  
**coordinate pair**  
set of two coordinates (one longitude value and one latitude value), representing a position on the earth model

Note 1 to entry: Within the scope of this International Standard, the earth model is embodied by ITRS and by ITRF coordinates.

**3.6**  
**core point**  
**CP**  
point belonging to the location reference core

**3.7**  
**destination location**  
location to be used as the end location of a journey for a route guidance application

**3.8**  
**extension point**  
**EP**  
point belonging to the location reference extension

**3.9**  
**great circle**  
circle on the surface of a sphere that has the same circumference as the sphere

Note 1 to entry: The connection between two points on a sphere along the great circle passing through the said two points is the shortest connection (airline distance or distance "as the crow flies").

### **3.10** **intersection point** **IP**

core point representing an intersection, located at places where the road section signature at the location changes

Note 1 to entry: The intersection point is one of the three defined core point types.

### **3.11** **location point** **LP**

core point that bounds or is located on the location

Note 1 to entry: Location points can coincide with intersection points or routing points. The start and the end of the location are always represented by a location point. Additional intermediate location points can be created to represent the shape of the location. The location point is one of the three defined core point types.

### **3.12** **location reference core**

point or set of points that is available in any location reference

Note 1 to entry: The rules in [Clause 8](#) control the data to be stored in the location reference core.

### **3.13** **location reference extension**

additional point or set of points, not belonging to the location reference core, available in a location reference under special conditions

Note 1 to entry: The rules in [Clause 8](#) specify the conditions under which a location reference extension is to be used and control the data to be stored in a location reference extension.

### **3.14** **next point**

point that is directly (topologically) connected to a given point, in a direction that is defined by the defined direction of the location

Note 1 to entry: A point can have zero or more next points.

### **3.15** **next point relation**

ordered pair of points (A, B) for which a direct connection exists from A to B along the path of the referenced location

Note 1 to entry: In the road network, a direct connection between points A and B exists when point B can be reached from point A *via* part of the road network, without visiting intermediate points in the location reference. This excludes points connected in a GDF graph *via* a node representing an intersection-not-at-grade. Such points are not considered to be directly connected.

### **3.16** **parallel carriageway indicator**

non-negative integer which indicates if a road segment contains more than one carriageway in parallel in the direction of interest, and how many

### **3.17** **precise geometry description**

shape along the location, coded on the most detailed level of the digital map, lying in a corridor with a defined perpendicular distance to the great circle connection between two successive points on a location

### 3.18

#### **road descriptor**

full road number, or a significant substring of the official road name

Note 1 to entry: The road descriptor is ideally three to five characters in length.

### 3.19

#### **road network location**

location which has a one-dimensional and continuous structure, being part of a road network

Note 1 to entry: It is a continuous stretch of that road network as realized in the database, which can cover different roads, and can be bounded on either side by an intersection. Alternatively it can be bounded on either side by a position on a road.

### 3.20

#### **road section signature**

##### **road signature**

value of the attribute quadruple {functional road class, form-of-way, road descriptor, driving direction}

### 3.21

#### **routing point**

##### **RP**

point used to reconstruct the location by route calculation

Note 1 to entry: RPs are intended to allow point-based matching to the map database of the end user. When such an RP match is found, the location then can be further reconstructed using the connectivity of the road network as represented in the map database of the end user. The routing point is one of the three defined core point types.

### 3.22

#### **side road section**

road section which is not part of the location to be referenced, but connected to it *via* an at least trivalent junction

### 3.23

#### **side road bearing**

bearing of the side road section

### 3.24

#### **side road direction**

driving direction of the side road section

### 3.25

#### **side road signature**

road section signature of a side road section

### 3.26

#### **status location**

location to be used to position location-based status information

EXAMPLE A location for speed limit information or traffic level information.

## 4 Abbreviated terms and attribute codes

### 4.1 Abbreviated terms

AGORA Implementation of Global Location Referencing Approach  
(Name of a European project 2000–2002)

DLR dynamic location reference (also known as DLR1 because this is the first LRM under  
dynamic profile)

|       |                                                                                                                                   |
|-------|-----------------------------------------------------------------------------------------------------------------------------------|
| GCIId | generic component identifier                                                                                                      |
| GDF   | Geographic Data Files (data model, data specification, and exchange standard for geographic data for road transport applications) |
| ISO   | International Organization for Standardization                                                                                    |
| ITRF  | International Terrestrial Reference Frame                                                                                         |
| ITRS  | International Terrestrial Reference System                                                                                        |
| ITS   | intelligent transport system                                                                                                      |
| LR    | location reference                                                                                                                |
| LRM   | location referencing method                                                                                                       |
| LRS   | location referencing system                                                                                                       |
| NLR   | network location reference                                                                                                        |
| RDS   | Radio Data System (digital data channel on FM subcarrier)                                                                         |
| RFU   | Reserved for Future Use                                                                                                           |
| SSF   | Syntax, Semantics, and Framing Structure (TPEG ISO/TS 18234-2)                                                                    |
| TMC   | Traffic Message Channel [system for broadcast of (digitally encoded) traffic messages on RDS]                                     |
| UML   | Unified Modelling Language                                                                                                        |
| VLC   | Variable Length Coding                                                                                                            |
| XML   | Extensible Markup Language                                                                                                        |

## 4.2 Attribute codes

|     |                               |
|-----|-------------------------------|
| AFR | accessible for routing flag   |
| BR  | bearing                       |
| CA  | connection angle              |
| CPI | connection point index        |
| DCA | distance measure CA           |
| DD  | driving direction             |
| DMB | distance measure bearing      |
| DSF | destination flag              |
| FC  | functional road class         |
| FCM | functional road class minimal |
| FW  | form of way                   |
| IT  | intersection type             |

|     |                                                                 |
|-----|-----------------------------------------------------------------|
| PCI | parallel carriageway indicator                                  |
| PD  | point distance                                                  |
| PDM | $D_{\text{perp-max}}$ (attribute to measure distance on shapes) |
| RD  | road descriptor                                                 |
| RDI | road descriptor of intersection                                 |
| RP  | routing point                                                   |
| SNI | subnetwork index                                                |

## 5 Objectives and requirements for a location referencing method

For details, see ISO 17572-1:2014, Clause 4.

For an inventory of location referencing methods, see ISO 17572-1:2014, Annex A.

## 6 Conceptual data model for location referencing methods

For details, see ISO 17572-1:2014, Clause 5.

For examples of conceptual data model use, see ISO 17572-1:2014, Annex B.

## 7 Specification of dynamic location references

### 7.1 General specification

Dynamic location referencing is also known as the AGORA-C method and relies on specific attributes that are mostly available in current digital map databases. Consequently, this LRM is adequate for LRSs that have a physical format specification based on GDF. The method relies on real-time access by the software to the original or translated values of the relevant attributes from its own digital map. This LRM will also be called “on-the-fly referencing” because the location reference code can be immediately discarded after internal definition of the location has been decoded. The dynamic location referencing concept is designed to compensate for differences that might exist between the map used at the sending system (the encoding side) and the map on board the receiving system (the decoding side). Such map differences can be caused by the receiving system using an older map data set of the same supplier, or *vice versa*, or the receiving system using a map data set from a different supplier.

Dynamic location referencing is often not as compact as pre-coded location coding. However, it is generally accepted that if dynamic location reference codes can on average stay within 50 bytes for problem and status locations, this would be acceptable in terms of bandwidth occupation. The specification focuses on LRSs for two purposes, and hence provides two building blocks.

#### — Location reference core

The location reference core is applicable to problem and status locations, e.g. road traffic messages. The location reference core is intended to provide location information much like ALERT-C location referencing<sup>[10]</sup> for which this specification actually intends to provide a lightweight dynamic location reference (not requiring pre-coding and the use of location tables). The location reference core prepares a function for additional robustness called precise geometry description in cases where a lack of information elements in the decoder’s map is expected or under conditions defined in the following clause.

## — Location reference extension

The location reference extension is applicable to use in routing to destination locations, i.e. the location of interest is to be used as the destination of a route guidance application. The location reference extension augments the location reference core to an extended location reference, in which the location reference extension is provided to ensure that a path from the location of interest to the nearest part of the road network defined in the location reference core exists.

A dynamic location reference is constructed as a set of information elements, which consists of points and related attributes. All points in both building blocks of the location reference (location reference core and location reference extension) together constitute a linear set, i.e. they form a list where each point in the list except the last one relates to the next point in the list, and to no other points. Each point can have one or more attributes.

On reception of this location reference, the receiving system needs to reconstruct the location as intended by the sending system. The encoding rules provided in [Clause 8](#) provide the necessary semantics both for creating the location code at the sending system and for interpreting this code in the receiving system. Thus, the role of the encoding rules is both to provide constraints for selecting and creating this set of information elements at the sending system and to provide a consistent interpretation basis for the receiving system to reconstruct the location reference as intended by the sending system.

This clause describes the building blocks for the dynamic location reference and specifies different types of attributes. [Clause 8](#) defines the Dynamic Profile LRM as a set of rules. These rules are mandatory, and any shall adhere to these. [Clause 9](#) defines the minimum requirements for any physical data format, which is for storing Dynamic Profile Location References of this LRM. [Annex D](#) describes hints to add optional attributes to the dynamic location reference and proposes a coding procedure, which can serve as a basis for the creation of a coding algorithm. Through application of the rules and the coding procedure, the sending system should be able to create a location reference that can be interpreted consistently by a variety of receiving systems if the physical format is well-known. For this reason two physical formats (binary and XML) are defined in [Annexes B](#) and [C](#), based on the logical format in [Annex A](#). This presents the opportunity to have at least one exchange format usable for the variety of LRS. If application of an LRM cannot implement either physical format of [Annex B](#) or [Annex C](#), the LRS might specify its own proprietary physical format, still fulfilling all format requirements defined by [Clause 9](#) of this International Standard. A third physical format defined in [Annex E](#) is specifically optimized for implicit areas and location references with precise geometry description and allows storing the location references in a very size efficient way.

Robustness of the codes is acquired by uniqueness. The information elements used and (certain aspects of) their combination shall be unique for these different parameters are defined as thresholds, e.g. the certain area around a point by the default distance  $D_{\text{search\_area}}$ . These parameters are specified in different rules and the best known values are given in [Table 3](#).

## 7.2 Location referencing building blocks

### 7.2.1 General

In [7.2.2](#) to [7.2.5](#), the building blocks for dynamic location reference encoding are defined and specified. These are points and attributes.

### 7.2.2 Points

The basis of the dynamic location reference is a set (or list) of points, which can be described as follows.

#### Point in general

A point can reference an intersection or can reference a position on the road network away from intersections. The set of points in a location reference constitute a next point relationship such that each point except the last one refers to one and only one other point (its “next point”).

Furthermore, points are distinguished as to which part of the location reference they belong to, the location reference core or the location reference extension.

### Core Point (CP)

Point belonging to the location reference core, which consists of a combination of three types of core points: location points, intersection points, and routing points.

a) Location Point (LP)

A core point that represents the start, an intermediate, or the end point of the real-world location to be referenced.

b) Intersection Point (IP)

A core point representing an intersection, located at places where the road section signature at the location changes.

c) Routing Point (RP)

A core point used to reconstruct the location by route calculation.

Each core point in the set of points in the location reference core shall represent at least one of the three core point types defined in this part of ISO 17572.

### Extension Point (EP)

Point belonging to the location reference extension. All points in the set of points in the location reference extension are, by definition, extension points.

## 7.2.3 Attributes

### 7.2.3.1 General

[Table 1](#) lists the defined attribute types for dynamic location references and their possible values. Note that some attributes relate to points and other attributes, to stretches of road network between points (possibly the whole length of the referenced location). An attribute that describes a characteristic of a linear stretch is linked in the location code to the point that is at the start point of the stretch. The following subclauses define some attributes in detail.

### 7.2.3.2 Functional Road Class

GDF defines this attribute with the purpose of “a classification based on the importance of the role that the road section or ferry connection performs in the connectivity of the total road network.” It is an enumerated list of 10 different values<sup>[5]</sup> as follows:

- main roads: the most important roads in a given network;
- first class roads;
- second class roads;
- third class roads;
- fourth class roads;
- fifth class roads;
- sixth class roads;
- seventh class roads;

- eighth class roads;
- ninth class roads: the least important roads in a given network.

NOTE 1 Dynamic location referencing uses this classification for distinguishing the parts of the road network, having a certain higher probability of existence in different databases. A standard map database will deliver this attribute as defined in GDF; however, the attribute is quite differently used between countries and providers. The location referencing method considers this in the rules by leaning only on categorizations with high congruence between different map databases.

NOTE 2 The attribute FC cannot be stored in some databases, but the encoder and decoder need to be able to derive it from other information available (speed, lanes, routing tables, etc.). For this purpose, [Table D.1](#) provides an interpretation of the most-used functional road classes in [Clause 8](#).

### 7.2.3.3 Bearing at a point

The bearing at a given point along a location is the angle between the geographic north and the straight-line connection from the given point to the intersection of the location with a measuring circle in the location direction (Pm), as depicted in [Figure 1](#). The radius of the measuring circle is defined with the attribute “Distance for Measure of Bearing” (DMB), and if it is not provided, with the (parameter)  $D_{m\text{-bearing}}$ .

NOTE 1 See [Table 3](#) for values of defined parameters.

The bearing is measured in clockwise direction. The measuring distance of at least attribute DMB, or respectively, (parameter)  $D_{m\text{-bearing}}$ , ensures robustness for observed interpretation differences.

NOTE 2 Road segments of less than 10 m length do not provide sufficient real-world semantics. Frequently, differences occur between maps of different map vendors due to interpretation differences allowed by GDF.

Once a point along a location has a bearing assigned, then there is a natural way of associating one and only one road segment with the point. The road segment associated with the point except for the last point is the road segment leading away from the point in the location direction of the point's bearing. Therefore, if the point is not a junction, then the associated road segment is simply the road segment on which the point is located. If the point represents a junction, then the associated road segment is one of the road segments incident at this junction and leading away from it in the direction of the point's bearing (see [Figure 1](#)).

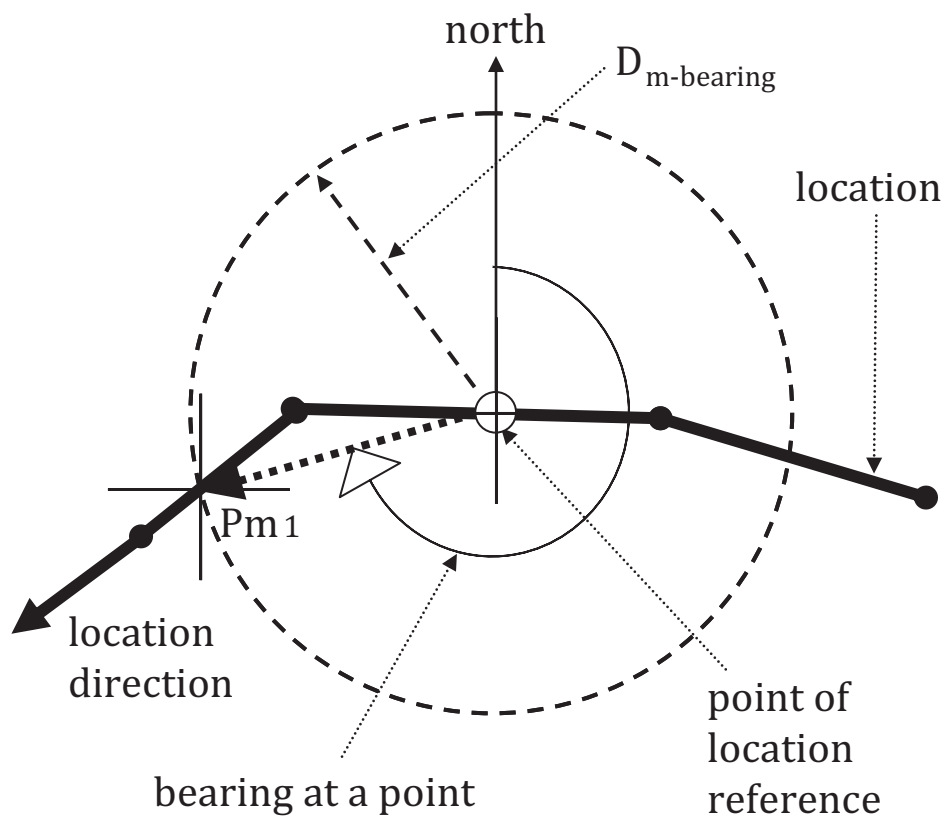


**Figure 1 — Bearing at a point (general case)**

In a case where a point is the last point of the location, the bearing is the angle from the intersection of the circle and the location reverse to the location direction (see [Figure 2](#)).

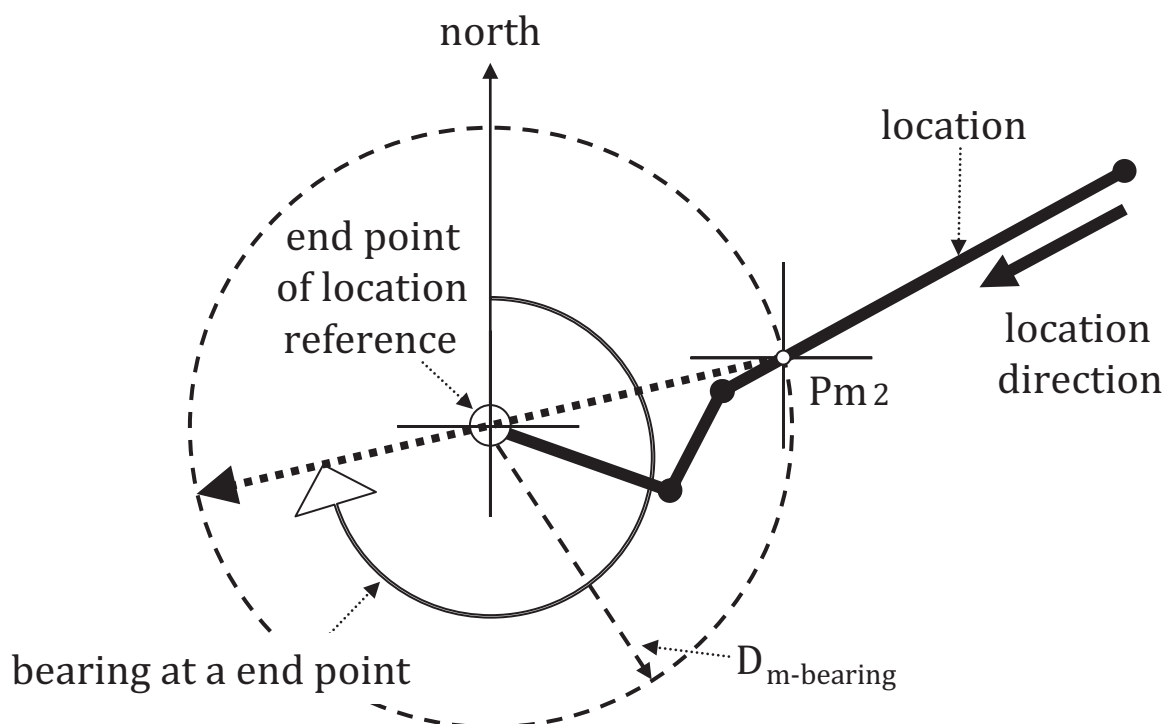


Figure 2 — Bearing at a point (special case for last point)

#### 7.2.3.4 Connection angle

In a case where, in addition to the bearing, a side road bearing is calculated, the attribute stored is the connection angle. The connection angle is the difference of the side road bearing ( $P_s$ ) and the bearing at a point ( $P_m$ ) (see Figure 3). Because, especially in intersections, differences in maps are potentially bigger, the connection angle is calculated with a higher measuring distance DCA than for the bearing. The attribute “Distance for measuring of Connection-Angle” (DCA), respectively (parameter)  $D_{m-co-angle}$ , ensures robustness for observed interpretation differences at intersections.

NOTE 1 See Table 3 for values of defined parameters.

NOTE 2 Road segments of less than a given length do not provide sufficient real-world semantics. Frequently, differences occur between maps of different map vendors due to interpretation differences allowed by GDF.

#### 7.2.3.5 Location direction

A location reference has an implicit direction, which is defined by the order of the points in the set of points that constitute the location reference core. The positive direction or from-to direction is from the first point in the set to the last point in the set. Note that this direction shall coincide with the direction to be referenced, if only one direction is referenced.

The attribute Location Direction (LD) has the following values:

- *aligned* The location has one direction, corresponding to the implicit direction defined by the order of the points.
- *both* The location has two directions, both in the implicit direction and in the reverse direction.

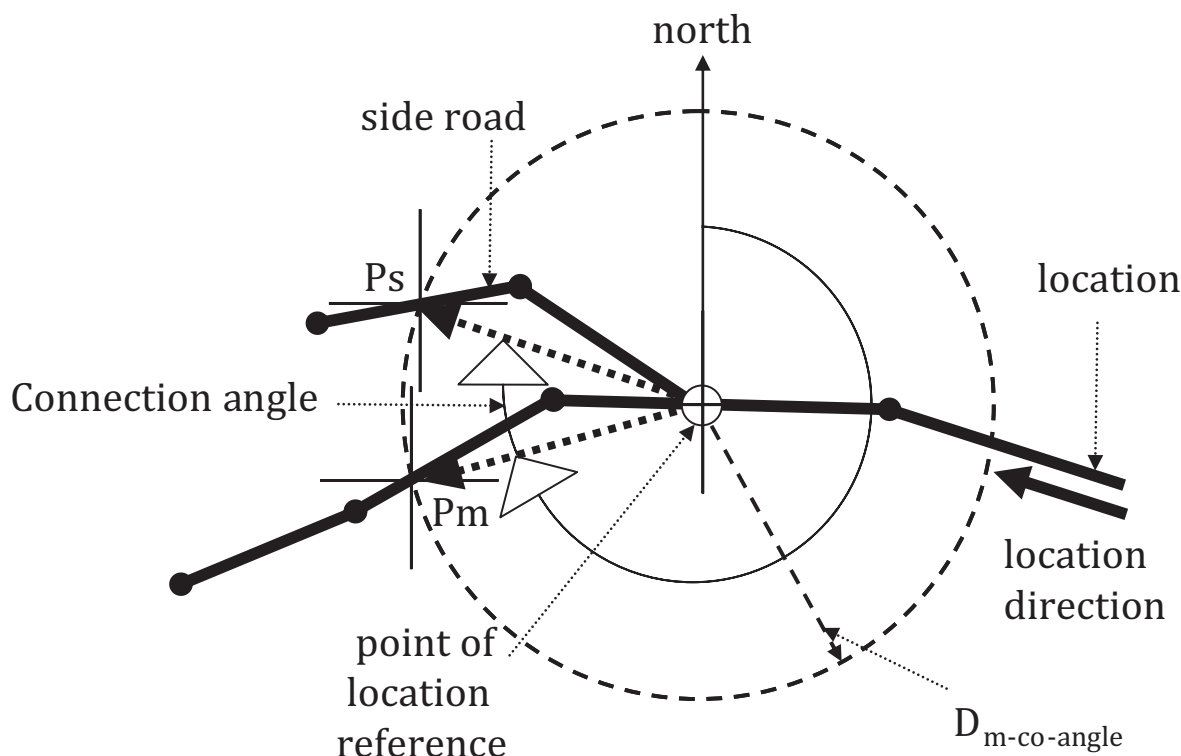


Figure 3 — Connection angle at a point

### 7.2.3.6 Location type

A location reference defines the type of the object to be referenced. The decoder will use this information to optimize its effort of decoding the location by a first presumption what type of object it is supposed to search for in its database. For this reason, the following values are defined (based on GDF and adapted for this context) with given purpose:

- *Intersection* The location is part of an intersection.
- *Restricted access road* The location is part of a road that is subject to restricted access for certain categories of road users (e.g. pedestrian zone).
- *Ferry* The location is part of a ferry connection.
- *Settlement* The location is part of a settlement (i.e. area with a residential, recreational, industrial, or military character).
- *Point-of-interest* The location is a point of interest (e.g. a specific route destination for a service).
- *Road* The location is a part of a road, without specific character, including motorways or other types of limited access roads.

### 7.2.3.7 Driving direction at a point

The driving direction (DD) at a point (along the location) expresses the legally permissible driving direction under normal conditions for passenger cars at the point relative to the bearing at the point. Stated in terms of the rule above, it expresses the driving direction of the road segment leading away from the point along the path in terms of the point's bearing. Alternatively, using the definition of the bearing of a point along a path of non-zero length, it can be determined as follows.

If the point is not the end point of the path, then the driving direction pertains, in terms of the most detailed level geometry, to the driving directions of the road segment pointing away from the point in location direction.

If the point is the end point of the path, then the driving direction pertains, in terms of the most detailed level geometry, to the driving directions of the road segment pointing towards the point in location direction.

NOTE In GDF 4.0 terminology, the attribute "Direction of Traffic Flow" for vehicle-type passenger cars. In a revision of the GDF standard (GDF5.0), this attribute is replaced by the attribute "Conditional Traffic Flow", which specifies direction of traffic flow per direction separately.

The driving direction can have the following values:

- *none* Driving is not allowed on the road segment.
- *aligned* The only allowed driving direction coincides with the bearing.
- *reverse* The only allowed driving direction is opposite to the bearing.
- *both* Both driving directions are allowed on the road segment.
- *undefined* Driving direction information is not available in the database.

### 7.2.3.8 Accessible for routing flag

The accessible for routing (AFR) flag at a point represents information for routing on road segments connected to a point. The flag is set to 0 (false) if the segment following the point is not accessible in the location direction. The flag is set to 1 (true) if the segment following the point is accessible in the location direction.

NOTE The attribute driving direction is related to the accessible for routing flag as follows: DD values "none" and "reverse" map to AFR value 0 (false), DD values "aligned", "both", and "undefined" map to AFR value 1 (true).

### 7.2.3.9 Parallel carriageway indicator

In case of a road, that has multiple carriageways for the same driving direction, which cannot be distinguished by other attributes of the given rules, the parallel carriageway indicator (PCI) is used to discriminate that particular part of the road. Parallel carriageway indicator counts the number of carriageways (PCIN) either in the horizontal direction or in the vertical direction (indicated by PCIT, values either "horizontal" or "vertical") and defines the sequence of parallel carriageways and a pointer to which of them is taken (PCII, the PCI index).

Some databases might lack the complex information of a road section constructed out of different carriageways. For this case, PCI defines the search area ( $D_{\text{search\_area}}$ ) as discriminating selector. All carriageways having all road section signature attributes equal are taken into account for the sequence of parallel carriageways. The PCII is counted starting with value 1 for the first carriageway.

Where the national convention is for all vehicular traffic proceeding in the same direction to be on the right side of the road, counting is performed with an angle of 90 degrees clockwise with respect to the bearing of the carriageway in question and from the leftmost carriageway for type "horizontal", or from the bottom most carriageway for type "vertical". Where the national convention is for all vehicular traffic proceeding in the same direction to be on the left side of the road, counting is performed with

an angle of 90° counter-clockwise with respect to the bearing of the carriageway in question and from the rightmost carriageway for type “horizontal”, or from the top-most carriageway for type “vertical”.

The search area enhancement indicates how much the default search area of (parameter)  $D_{\text{search\_area}}$  is enhanced to find all carriageways in question. The enhancement ensures, that for roads having a larger extent than  $D_{\text{search\_area}}$ , the whole sequence of carriageways is counted. See [Figure 4](#) as an example.

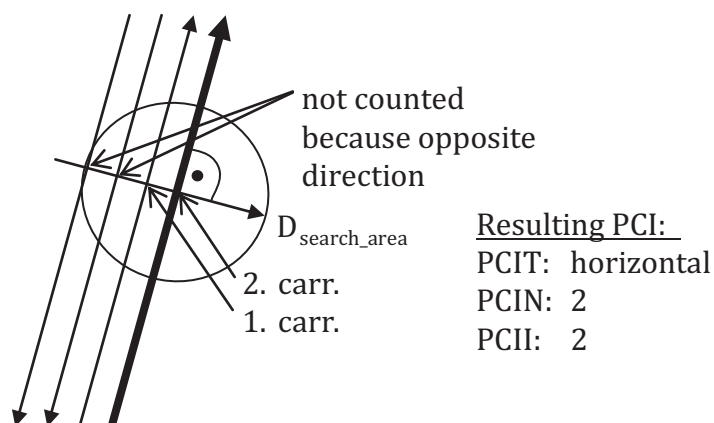


Figure 4 — Example of parallel carriageway indicator

#### 7.2.3.10 Perpendicular distance

To follow the shape of the road in a narrow corridor the attribute perpendicular distance is measured. The perpendicular distance is defined as the maximum distance between the straight line connection, between two given points on a road segment and the shape of the road segment given from the most detailed level geometry of the database. In RULE-10 and RULE-31, the perpendicular distance is required to be less than a certain value.

[Figure 5](#) illustrates for any point of the road elements on the road section between successive points A and B of the original path of the location, the perpendicular distance  $D_{\text{perp}}$  to the straight line connecting points A and B shall be less than attribute (PDM) respectively (parameter)  $D_{\text{perp-max}}$ . If not, then one or more intermediate location points need to be inserted. The open circles reflect shape points which are given from the most detailed level geometry of the map database of the encoder side.

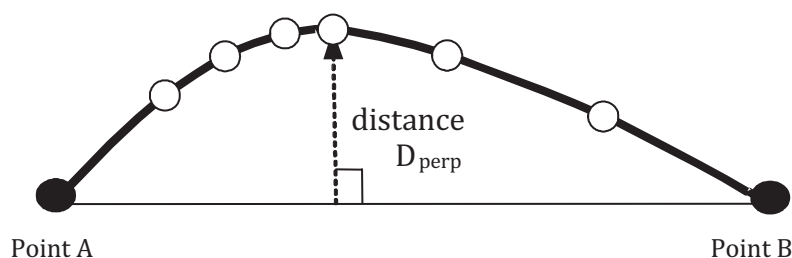


Figure 5 — Calculation of perpendicular distance

#### 7.2.3.11 Distance to next point

Between a point and the next point along the path of the location reference the driving length is accumulated. The attribute Point Distance (PD) at a point indicates the driving length from this point along the path to that point having again the attribute PD or until the last point of the location reference.

### 7.2.4 Next-point relationship

A point B is a next point to another point A only if there is a direct connection between A and B along a path of a location reference. Refer to [Figure 6](#) for the illustration. Point A is connected with B and B is connected with C, but A is not directly connected with C. The transitive closure of the next point relation indicates whether from a point A the point C can be reached following the path as defined by a sequence of one or more next-point relations. For example, in [Figure 6](#), the transitive closure also includes the directed relation from point A to point C.



Figure 6 — Explanation of direct connection between points

### 7.2.5 Attribute type list

[Table 1](#) defines the general attribute types and their value specification.

Note that in the annexes describing a physical format, the value definition for some of the attributes can be more compact (reduced resolution or reduced value set) than in [Table 1](#). This is done to achieve small code size in the physical format, while maintaining high hit rate.

[Table 1](#) uses the following notations and base data types:

- $[x-y]$  definition of range minimum includes x and maximum includes y;  
missing x or y defines open range;
- *Boolean* value having only two states namely true or false;
- *string* string of textual characters, usage is given by amended format description;
- *enumeration* enumeration of fixed definitions distinctly indicated by one integer value;
- *integer* signed integer value within a range from negative to positive values;
- *unsigned* unsigned integer value with non-negative values only;
- *structure* set of several sub-data types grouped together.

## 8 Encoding rules

### 8.1 General

In this clause, the dynamic profile encoding rules are specified. In [8.2](#), the general point representation and selection rules are specified, common to both the core and location reference extension. In [8.3](#) and [8.4](#), respectively, the rules for the location reference core and the location reference extension are specified.

The location reference core provides a minimum specification for a location reference, common for all locations. For use in intelligent transport systems, the location reference core provides a complete and sufficient set of rules for all locations to be used as problem and/or status locations. In the location reference extension then additional rules are provided especially for locations to be used as destination locations. These additional rules complement and extend the rules for the location reference core for such locations.

Table 1 — Defined attribute types and attribute values

| Abbreviation                                                                                                                                                                                                                                                                                  | Attribute name                                                | Data type   | Description                                                                                                                                                                                                                                                                       | Description of values and range                                                                                                                                                                                                                                                                                                                                                                                                              |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| AFR                                                                                                                                                                                                                                                                                           | accessible for routing                                        | Boolean     | Indicates whether the road segment following a point is accessible for routing or not (see 7.2.3.8 for detailed definition).                                                                                                                                                      | — <i>false</i> , if not accessible<br>— <i>true</i> , if accessible                                                                                                                                                                                                                                                                                                                                                                          |
| BR                                                                                                                                                                                                                                                                                            | bearing                                                       | unsigned    | The attribute defines at a given point along a location, the angle between the geographic north and the straight line connection from the given point to the intersection of the location with a measuring circle in the location direction (see 7.2.3.3 for further definition). | (in degrees)                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| CA                                                                                                                                                                                                                                                                                            | connection angle                                              | integer     | The attribute defines the angle difference between side road bearing and bearing at a point (see 7.2.3.4 for further definition).                                                                                                                                                 | (in degrees)                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| CPI                                                                                                                                                                                                                                                                                           | connection point index                                        | unsigned    | The attribute defines the index of the core point in a location reference that a location reference extension or subnetwork location connects to.                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| DCA                                                                                                                                                                                                                                                                                           | distance for measure of connection angle ( $D_{m-co-angle}$ ) | unsigned    | Optional value in case that not parameter $D_{m-co-angle}$ was used.                                                                                                                                                                                                              | (in metres)                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| DD                                                                                                                                                                                                                                                                                            | driving direction                                             | enumeration | The attribute defines the allowed legal driving direction (see 7.2.3.7).                                                                                                                                                                                                          | — <i>none</i> , if driving is not allowed on this road segment<br>— <i>aligned</i> , if the only allowed driving direction coincides with the bearing<br>— <i>reverse</i> , if the only allowed driving direction is in opposite direction of the bearing<br>— <i>both</i> , if both driving directions are allowed on the road segment<br>— <i>undefined</i> , in case that the attribute is not existing in the used database <sup>a</sup> |
| <sup>a</sup> The values 0-3, i.e. none, aligned, reverse, and both, are defined as like GDF. For compatibility reason, “undefined” has been specified as 4, which can be stored as another bit in the physical format.<br>The physical format specification can define “undefined” as absent. |                                                               |             |                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                              |

**Table 1** (continued)

| Abbreviation                                                                                                                                                                                                                                                                                               | Attribute name                                             | Data type   | Description                                                                                                                                                                                                                                                             | Description of values and range                                                                                                                                                                                                                                                             |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| DMB                                                                                                                                                                                                                                                                                                        | distance for measure of bearing ( $D_{m\text{-bearing}}$ ) | unsigned    | Optional value in case that not parameter $D_{m\text{-bearing}}$ was used.                                                                                                                                                                                              | (in metres)                                                                                                                                                                                                                                                                                 |
| DSF                                                                                                                                                                                                                                                                                                        | destination flag                                           | Boolean     | Destination flag is set to true in case that a linear location reference is used as a destination location to show which point determines the intended destination object.                                                                                              | — true in case destination shall be positioned at this point                                                                                                                                                                                                                                |
| FC                                                                                                                                                                                                                                                                                                         | functional road class                                      | enumeration | Road classification based on the importance of a road or ferry connection in the connectivity of the total road network as defined in 7.2.3.2. If the database lacks of this attribute, a subsiding, similar classification of importance is needed; refer then to D.3. | — FC 0 - Main road<br>— FC 1 - First class road<br>— FC 2 - Second class road<br>— FC 3 - Third class road<br>— FC 4 - Fourth class road<br>— FC 5 - Fifth class road<br>— FC 6 - Sixth class road<br>— FC 7 - Seventh class road<br>— FC 8 - Eight class road<br>— FC 9 - Ninth class road |
| FCM                                                                                                                                                                                                                                                                                                        | minimal functional road class ( $FC_{\min}$ )              | enumeration | Most important road class of road elements comprising the original path of the location extension for at least a stretch of length of $D_{\text{search-area}}$ as defined in attribute FC.                                                                              | (values as defined for attribute FC)                                                                                                                                                                                                                                                        |
| <sup>a</sup> The values 0-3, i.e. none, aligned, reverse, and both, are defined as like GDF. For compatibility reason, "undefined" has been specified as 4, which can be stored as another bit in the physical format.<br><sup>b</sup> The physical format specification can define "undefined" as absent. |                                                            |             |                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                             |

Table 1 (continued)

| Abbreviation                                                                                                                                                                                                                                                                                             | Attribute name    | Data type   | Description                                                                                                                                                                                                                                        | Description of values and range                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| FW                                                                                                                                                                                                                                                                                                       | form of way       | enumeration | Physical road type. This attribute is related to the corresponding GDF attribute. However, the attribute here is restricted to a smaller list of definitions. In case that the database lacks this attribute, the value "undefined" shall be used. | <ul style="list-style-type: none"> <li>— <i>undefined</i></li> <li>— <i>motorway</i></li> <li>— <i>multiple carriageway (which is not a motorway)</i></li> <li>— <i>single carriageway</i></li> <li>— <i>roundabout circle</i></li> <li>— <i>traffic square</i></li> <li>— <i>enclosed traffic area</i></li> <li>— <i>slip road</i></li> <li>— <i>service road</i></li> <li>— <i>car park entrance or exit</i></li> <li>— <i>service entrance to or exit</i></li> <li>— <i>pedestrian zone</i></li> <li>— <i>walkway</i></li> </ul> |
| IT                                                                                                                                                                                                                                                                                                       | intersection type | enumeration | Categorization of an intersection at the given point. If the database lacks of this information the value "undefined" shall be used.                                                                                                               | <ul style="list-style-type: none"> <li>— <i>undefined<sup>b</sup></i></li> <li>— <i>interchange involving motorways or other limited access roads (complex)</i></li> <li>— <i>roundabout</i></li> <li>— <i>complex road crossing not of type "interchange involving motorways or other limited access roads" or "roundabout"</i></li> <li>— <i>simple road crossing</i></li> <li>— <i>traffic square</i></li> <li>— <i>bivalent intersection (i.e. point where one or more attributes change)</i></li> </ul>                        |
| <p><sup>a</sup> The values 0-3, i.e. none, aligned, reverse, and both, are defined as like GDF. For compatibility reason, "undefined" has been specified as 4, which can be stored as another bit in the physical format.</p> <p>The physical format specification can define "undefined" as absent.</p> |                   |             |                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

Table 1 (continued)

| Abbreviation                                                                                                                                                                                                                                                                                | Attribute name                       | Data type            | Description                                                                                                                                                                                                                                                          | Description of values and range                                                                                                                                                                                                       |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| LD                                                                                                                                                                                                                                                                                          | location direction                   | enumeration          | The attribute defines the direction of the location (see <a href="#">7.2.3.5</a> ).                                                                                                                                                                                  | <ul style="list-style-type: none"> <li>— <i>aligned</i>, if only the direction coinciding with the direction of the location is referenced</li> <li>— <i>both</i>, if both directions of the location are to be referenced</li> </ul> |
| LPF                                                                                                                                                                                                                                                                                         | location point flag                  | Boolean              | Indicates, that the corresponding point is flagged as location point.                                                                                                                                                                                                | <ul style="list-style-type: none"> <li>— <i>true</i>, in case that point is a location point.</li> </ul>                                                                                                                              |
| LT                                                                                                                                                                                                                                                                                          | location type                        | enumeration          | Specifies the location type of the location that is referenced (defined in <a href="#">7.2.3.6</a> ).                                                                                                                                                                | <ul style="list-style-type: none"> <li>— <i>intersection</i></li> <li>— <i>restricted access road</i></li> <li>— <i>ferry</i></li> <li>— <i>settlement</i></li> <li>— <i>point-of-interest</i></li> <li>— <i>road</i></li> </ul>      |
| NIT                                                                                                                                                                                                                                                                                         | number of intermediate intersections | unsigned             | Number of intersections that follow a point until the next point of same type excluding the intersection of that point itself.                                                                                                                                       |                                                                                                                                                                                                                                       |
| PCI                                                                                                                                                                                                                                                                                         | parallel carriageway indicator       | structure            | The attribute indicates which carriageway is chosen if there are several physically separated carriageways leading in the same direction. The attribute consists of five parts combined in one structure; refer to <a href="#">7.2.3.9</a> for detailed description. | structure (see subsections:)                                                                                                                                                                                                          |
| PCISF                                                                                                                                                                                                                                                                                       |                                      | Boolean              | 1) Indicator whether default search area is to be used or optional search area enhancement (item #5) is specified                                                                                                                                                    | <ul style="list-style-type: none"> <li>— <i>false</i>, if no search area enhancement is defined</li> </ul>                                                                                                                            |
| PCIT                                                                                                                                                                                                                                                                                        |                                      | Boolean              | 2) Parallel carriageway indicator type                                                                                                                                                                                                                               | <ul style="list-style-type: none"> <li>— <i>true</i>, if the search area enhancement is defined</li> <li>— <i>false</i> for type <i>horizontal</i></li> <li>— <i>true</i> for type <i>vertical</i></li> </ul>                         |
| PCII<br>CIN                                                                                                                                                                                                                                                                                 |                                      | unsigned<br>unsigned | 3) Parallel carriageway sequence number<br>4) Number of carriageways                                                                                                                                                                                                 |                                                                                                                                                                                                                                       |
| <p>The values 0-3, i.e. none, aligned, reverse, and both, are defined as like GDF. For compatibility reason, "undefined" has been specified as 4, which can be stored as another bit in the physical format.</p> <p>The physical format specification can define "undefined" as absent.</p> |                                      |                      |                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                       |

Table 1 (continued)

| Abbreviation                                                                                                                                                                                                                                                                                                          | Attribute name                                           | Data type | Description                                                                                                                                                                                                                                                                                                                                                                                                                         | Description of values and range                                                                                           |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|
| PCIS                                                                                                                                                                                                                                                                                                                  |                                                          | unsigned  | 5) (Optional) Search area enhancement distance in metres indicating how much the default search area (specified as the parameter $D_{\text{search-area}}$ ) has been enlarged (radius = $D_{\text{search-area}} + \text{search area enhancement distance}$ ).                                                                                                                                                                       | (in metres)                                                                                                               |
| PD                                                                                                                                                                                                                                                                                                                    | point distance                                           | unsigned  | Network (driving) distance as defined by the next point relationship of a given point to the next point along the path that has a PD attribute or until the end of the location.                                                                                                                                                                                                                                                    | (in metres)                                                                                                               |
| PDM                                                                                                                                                                                                                                                                                                                   | perpendicular distance maximum ( $D_{\text{perp-max}}$ ) | unsigned  | Perpendicular distance as maximal distance between the approximated points and the original path of the most detailed level of the map in metres (see 7.2.3.10).                                                                                                                                                                                                                                                                    | (in metres)                                                                                                               |
| RD                                                                                                                                                                                                                                                                                                                    | road descriptor                                          | string    | All characters of the full national road number of the road, if it exists; otherwise at most five characters of the (GDF attribute) official name of the road. Less than five characters can be chosen, with a minimum of three, if the resulting descriptor is a unique string in the search area of a radius of $D_{\text{search-area}}$ . In case that neither road name nor road number is available, the string is left empty. | For string format definition, refer to ISO 17572-1:2014, Annex E or to the corresponding physical data format definition. |
| RDI                                                                                                                                                                                                                                                                                                                   | road descriptor of intersection                          | string    | Sometimes a complex intersection like a roundabout has a name of its own. This can be represented by this attribute in an attributes list for the point.                                                                                                                                                                                                                                                                            | For string format definition, refer to the corresponding physical format definition.                                      |
| SNI                                                                                                                                                                                                                                                                                                                   | subnetwork index                                         | unsigned  |                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                           |
| <p><sup>a</sup> The values 0-3, i.e. none, aligned, reverse, and both, are defined as like GDF. For compatibility reason, "undefined" has been specified as 4, which can be stored as another bit in the physical format.</p> <p><sup>b</sup> The physical format specification can define "undefined" as absent.</p> |                                                          |           |                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                           |

Each point used in the location reference can be given additional attributes in [Table 1](#) to additionally discriminate the location reference more precisely than defined in the following rules.

**NOTE** In some cases some constituent attributes of the road signature (see definition in [3.20](#)) may not be available in the encoding map. For such case a value like “undefined” is provided per attribute. In case the encoder lacks defined values for such attributes it clearly reduces the feasibility for the decoder to interpret the location reference correctly. However, as including an “undefined” value may be the only way to enable referencing, in this International Standard a specification of “mandatory if exist” attributes has been selected, but with a clear disclaimer of liability for a 95 % decoding success rate when some attribute values in the road signature are undefined.

## 8.2 General point representation and selection rules

**RULE-01** Each point shall be represented by a coordinate pair in ITRS longitude and latitude coordinates, reflecting its position on the surface of the earth.

Note that in this International Standard, the coordinates resolution for common ITS applications is in the order of magnitude of 10 microdegrees. However, for future applications (e.g. pedestrian navigation), a higher resolution might be required. This International Standard specifies therefore a high resolution format (in the order of magnitude of 1 microdegree). The resolution shall be signalled in the physical format.

**RULE-02** Points are selected along the location in one direction, such that they form a next-point relationship. If only one direction is to be referenced, the point selection direction shall coincide with the direction to be referenced.

**NOTE** Each point in a location reference can be addressed using an index. This index is implicitly defined by the order of the points and counted from the first point of a location reference core, starting at value zero. The index is used by the attribute PCI in RULE-29, RULE-41, and RULE-42 to connect a location reference extension or subnetwork location to a point of a location reference core.

**RULE-03** Each point shall be located on the path which constitutes the nominal or assumed centre-line of the location. Each point shall be selected from the most detailed level of the digital map database.

**RULE-04** In case of a road, which is composed of a number of carriageways that are physically divided, the path follows the carriageway to be referenced, and points are located on that carriageway.

## 8.3 Location reference core encoding rules

In this subclause, the rules for the location reference core are listed. The location reference core provides a minimum specification for a location reference, which will form the common part for all locations to be referenced. The location reference core is encoded in the location reference core representation.

### 8.3.1 Location selection

**RULE-05** The location reference indicates the referenced location direction or directions (attribute LD). In case of absence of attribute LD in the location reference, location direction is expected to be aligned. If the location to be referenced or part of it is separately digitized for each direction, or contains complex intersections, each direction shall be considered as a separate location, and be separately coded if both directions are to be referenced.

**RULE-06** The location type (attribute LT) of the location to be referenced shall be indicated.

### 8.3.2 Location reference core point selection

**RULE-07** Each core point of the location reference core shall be at least one of the three point types defined in 7.2.2: a location point, an intersection point, or a routing point, or a combination of these three core point types.

NOTE Each point is characterized by the used attributes. The location point is signalled explicitly; routing and intersection points are signalled by their attributes.

**RULE-08** All points of the location reference core together shall constitute a logically ordered set (list), from the defined start point of the location to the defined end point, where each point has topologically (i.e. in the network) a direct connection (i.e. not *via* another point in the list) with the next point in the list. In this way, the list implicitly defines the next-point relationship (see 7.2.4).

### 8.3.3 Core point selection — Location points

**RULE-09** All selected points lying on the path of the location to be referenced shall be indicated (attribute LPF) as location point. As a minimum, the start and end point of the real-world location to be referenced shall be represented by a location point.

NOTE The location reference can include points on the path of the location (like *interim* intersections) that do not originate from the rules. Such points are coded with type “location point” only.

**RULE-10** The segment length along the original path of the location between successive location points shall not exceed the great-circle (airline) distance by more than the greater of 10 m or 5 % of the great-circle (airline) distance. In case that a point needs to be inserted, it shall be placed at the position of greatest perpendicular distance and both subsegments shall apply to this rule again.

Precise geometry description shall be used to determine the need of inserting location points, to avoid ambiguity, in situations according to the following conditions:

— if attributes FW, RD, and DD are missing (i.e. not present or not reliable or not usable) for the given segment

and

— for an LP, another road section exists within (parameter  $D_{\text{search-area}}$ ); or

— for an IP, another IP of a different intersection exists within (parameter  $D_{\text{search-area}}$ ); or

— for an RP, another RP is identifiable on a different road section being within (parameter  $D_{\text{search-area}}$ ) and not having a unique bearing as defined in RULE-25.

Precise geometry description requires that any part of the actual segment between successive location points shall have a perpendicular distance  $D_{\text{perp}}$  to the straight line connection of the points of at most of value  $D_{\text{perp-max}}$ . The value of  $D_{\text{perp-max}}$  defined as attribute PDM along that segment shall be provided at the first point belonging to the segment and has a default value of (parameter)  $D_{\text{perp-max}}$ .

The precise geometry description shall at least consider a stretch of (parameter)  $D_{\text{margin}}$  length. In case of complex intersections, the margin for precise geometric description shall be counted away from the IP or RP chosen. The end of the precise geometry description segment is defined by that point setting attribute PDM to 0.

NOTE The shape of the location, hence, is restricted to lie within a narrow corridor around the road sections represented in the location.

### 8.3.4 Core point selection — Intersection points

**RULE-11** Each point along the location at which the road section signature changes shall be represented by an intersection point. If the last point of the location is an intersection, it constitutes an intersection point, even if the road section signature does not change at that point. In this particular case the intersection point cannot carry all attributes that did not change, for example, for bandwidth saving reasons. The first core point of the set of points is in any case an intersection point, even if it is not an intersection, to provide the signature for the first road section. In case that the database lacks of attributes the value “undefined” as specified per attribute shall be used. If the attribute values used change to “undefined” due to the database, there shall not be an insertion of an intersection point. If only the attribute FW change to “roundabout circle” or “traffic square” and the location continues after these intersections with a road section having the same signature as the section before the intersection, there shall be no insertion of an intersection point.

**NOTE 1** The road section signature generally changes at an intersection, but it can also change without an intersection being present, e.g. a name changes part way along a road, this intersection point is then defined as a bivalent intersection. In case that a road has more than one name or number, the one taken does determine if a new IP is to be set.

**NOTE 2** In case that an intersection has a name different from any road connected to it (e.g. the name of a roundabout), the attribute RDI can be added as an optional attribute.

**RULE-12** An intersection point is located at the intersection which it represents. If the intersection is a simple crossing, the position of its junction is chosen as the intersection point. If the intersection is a complex intersection, a point is chosen within the intersection, on the path of the location, at the first junction of the intersection counted in the direction of the location, where the signature changes.

**NOTE** [Figure 7](#) shows examples where to apply intersection points in complex intersections.

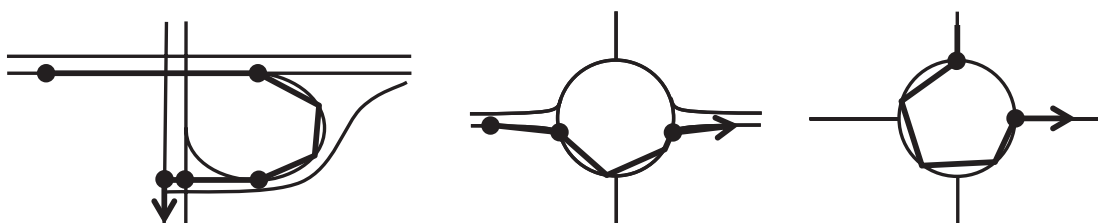


Figure 7 — Examples for positioning of intersection points

**RULE-13** If the end point or the start point of the location to be referenced is less than distance (parameter)  $D_{\text{search-area}}$  away, along a path in the road network, from an intersection, which is not part of the location (measured along a path in the road network in the location direction or in reverse location direction), then this intersection point shall be included in the location reference as the last point, or the first point, respectively.

**NOTE 1** [Figure 8](#) shows an example how to measure the distance at the beginning and end of a location; the distance being smaller than  $D_{\text{search-area}}$  would cause inserting the intersection point as first point of the location reference.

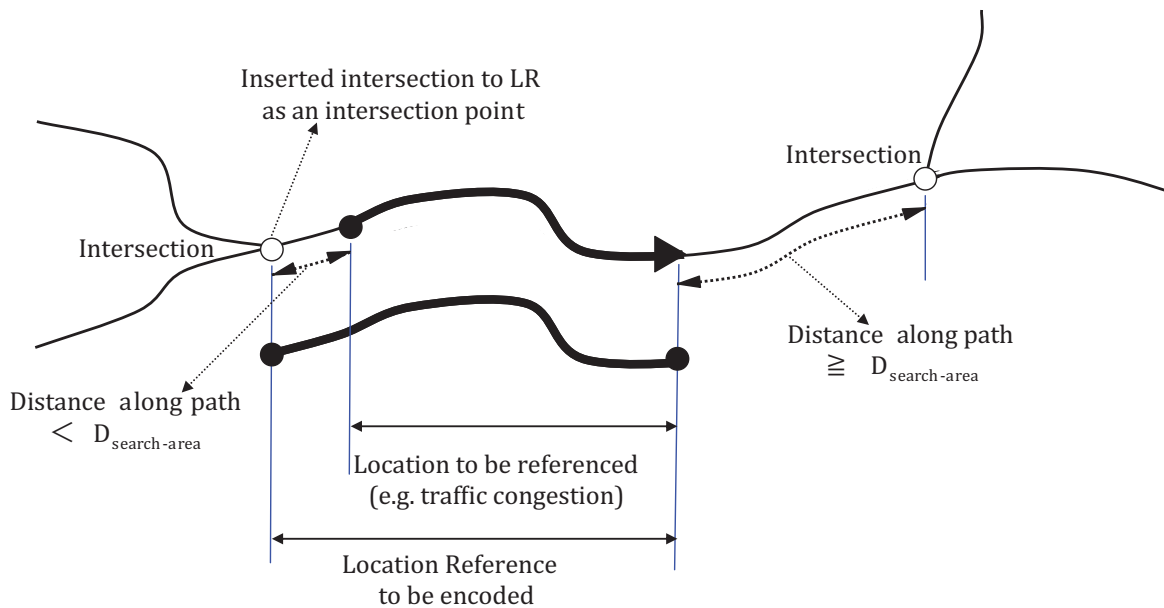


**Figure 8 — Example for RULE-13**

NOTE 2 Intersections have clear real-world semantics and provide an added measure of robustness for geometric inaccuracies. RULE-13 is intended to enable relative positioning of start and end point of the desired location. It is a known issue that maps might differ especially in the representation of intersections. For the decoding, it is important not to start on the wrong side of the intersection because this would wrongly include (or exclude) the intersection. [Figure 9](#) shows a case where an intersection is located at a different position in the decoder map. For this situation, the decoder should decide to include (or exclude) the remainder of the referenced location on the wrong side from the intersection relative to its internal position of the intersection. Attribute PD can be used to explicitly define known length (offset) between IP and begin of location. Shifting of location is done relative to the matched intersection either with the given offset or by cutting the extent such that the location does not refer to the wrong side of the intersection unintentionally.

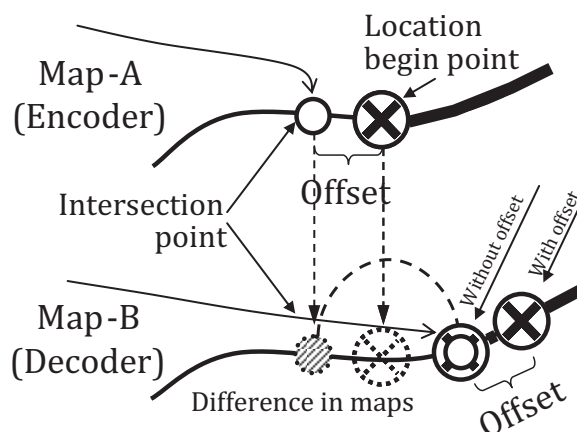


**Figure 9 — Example for moving beginning of location reference core relative to the intersection**

### 8.3.5 Core point selection — Routing points

**RULE-14** A routing point shall be chosen only where the road segment determining the routing point bearing, and in case of an intersection point, also the road segment determining the side road bearing, have a length of at least for the bearing (parameter)  $D_{m\text{-bearing}}$ , and for the side road bearing (parameter)  $D_{m\text{-co-angle}}$ .

**NOTE** See definition of bearing in 7.2.3.3. Road segments of less than a given length do not provide sufficient real-world semantics. Frequently, differences occur between maps of different map endsors due to interpretation differences allowed by GDF.

**RULE-15** At least the first and the last core point shall be routing points.

The location reference shall contain a sufficient and minimal number of routing points to allow unambiguous reconstruction of the location in the map of the sending system.

**NOTE 1** In case that the road segments of the start or end point of the location does not meet the requirements of RULE-14, the RP is chosen at the nearest point before the start or behind the end point that meets the requirements of RULE-14.

**NOTE 2** Additional core points can be introduced following RULE-13.

**RULE-16** Each routing point shall identify a unique point on a unique road segment on the map of the sending system. Uniqueness is determined on the combination of all relevant attributes defined in 7.2.3 in the encoder map. Uniqueness shall hold within a default radius of (parameter)  $D_{\text{search-area}}$ , or, if present, the enhanced value as specified in RULE-27 (the parallel carriageway indicator, attribute PCI). Each routing point shall identify a unique point on a unique road segment on the map of the sending system. Uniqueness is determined on the combination of all relevant attributes defined in 7.2.3 in the encoder map. Uniqueness shall hold within a default radius of (parameter)  $D_{\text{search-area}}$ , or, if present, the enhanced value as specified in RULE-27 (the parallel carriageway indicator, attribute PCI). The functional road class attribute shall only be considered a unique identification when there is at least a road class difference of two levels with other candidate road segments.