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Intelligent transport systems — Geographic Data Files (GDF) — GDF5.0

Systèmes intelligents de transport — Fichiers de données géographiques (GDF) — GDF5.0

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 14825 was prepared by Technical Committee ISO/TC 204, *Intelligent transport systems*.

This second edition cancels and replaces the first edition (ISO 14825:2004), which has been technically revised.

Introduction

By the late 1980s, producers and users of digital road map data became increasingly aware of the need for a common data interchange standard. Lack of such a standard was seen as an impediment to the commercial growth and success of industries using such data. Before the advent of the Intelligent Transport Systems (ITS) industry, development of spatial data interchange standards was done mostly on a regional basis and not designed for the specialised requirements of road-transport-related applications. The establishment of ISO/TC 204 in 1993 sought to remedy the lack of international standards for ITS. The technical committee is divided into 16 working groups. Working Group 3 (WG 3) was charged with the responsibility of developing standards to promote interchangeability of map data and interoperability of systems using map databases.

The work of WG 3 started in 1994 with a review of the available regional standards documents, including standards developed by the Japan Digital Road Map Association (JDRMA) and developments in the US that resulted in the Spatial Data Transfer Standard (SDTS). European standardization efforts resulted in a standard called GDF3.0 (Geographic Data Files), which eventually was adopted as the basis for internationalized developments, leading to the publication of GDF4.0 in 2004.

In the 1990s, the GDF standard was instrumental in enabling the European business-to-business (B2B) market for in-vehicle navigation in that it provided interoperability for exchanging digital map data between map manufacturers and navigation system integrators. The GDF specifications provided a base for both the capturing of geographic content and the exchanging of it. Its original design foresaw a powerful, application-independent model, while its initial rendition as a standard specifically addressed the requirements for the richness of navigable map databases. Since then, GDF has evolved in terms of boosted data modelling capabilities, broadened international applicability, expanded geographic domains, and diversified exchange formats. As a result, GDF covers a wide range of application domains and has been adapted to many geospatial technologies

The current document presents the specification for GDF5.0, resulting from approximately 30 rounds of meetings held between 2001 and 2008 and involving experts from Australia, Canada, the Czech Republic, France, Germany, Japan, the Republic of Korea, the Netherlands, and the United States of America. Extensive activities towards harmonization with ISO/TC 211 standards were undertaken. Major GDF5.0 enhancements include UML model migration and refinements, harmonization with linear referencing and geospatial web standards, support for 3-D content and time coordinates, comprehensive character set and phonetic representations, and new XML- and SQL-based delivery formats.

The specification of this International Standard is divided into several parts.

After the introductory clauses, the overall conceptual data model is specified. In it, the basic building blocks of GDF and their interrelations are explained. It contains a specification of the different types of topology supported by this International Standard. It furthermore describes how database representations of real world objects, referred to as Features, are defined. It describes the characteristics of Features, called Attributes, and the topological and non-topological interrelations between Features. Finally, it describes the organization of the Features in GDF. Semantically, Features are organized in different Feature Themes. Logically and physically, Features are organized in Sections by area or in Layers by contents.

In the Feature Catalogue, the different Features supported by this International Standard are defined. A special case is the Features from the Services Feature Theme. Because the requirements for this Feature Theme are highly market-oriented, the Services Feature Theme does not contain any normative Features, but contains an annex comprising an informative list of service definitions to assist users of this International Standard (see Annex C).

In the Attribute Catalogue, the different characteristics of Features, called Attributes, are defined. A usage matrix outlines applicability of Attributes per Feature Theme and per Relationship.

In the Relationship Catalogue, the different non-topological (i.e. semantic) Relationships which Features can have are defined. Relationships can relate Features of different Feature Themes, or those from the same or different Section and/or Layer.

In the Feature representation rules, the possible geometrical ways in which the individual Features can be represented are specified for each topology type. This International Standard supports zero-, one- and two-dimensional primitives and up to four-dimensional coordinates.

The specification of Features, Attributes and Relationships by no means dictates mandatory inclusion. The actual contents of GDF, apart from a minimum set of metadata elements as specified in the delivery formats, is not specified by this International Standard since this is considered to be an issue between clients and vendors. This International Standard allows the introduction of user-defined Features, Attributes and Relationships.

In certain cases, different alternative ways of modelling and representation are offered. Representing Features in different geographical areas also may require the use of different basic representation mechanisms such as character sets, projection systems, etc. It is important that all these individual choices associated with GDF are specified. Furthermore, GDF should essentially be self-contained and be readable without any external specification. In order to make this possible, this International Standard specifies ways of describing GDF by means of metadata, captured by the Metadata Catalogue.

Apart from providing a standard for the definition of geographic road databases, this International Standard also specifies mechanisms for data exchange and delivery. In order to facilitate the definition and exchange of data, a logical view of the data organization is important. This logical view is presented in the Logical Data Structures. The data structures are specified using the data description language ESN.

Three physical realisations for data exchange and delivery are specified; the Media Record Specifications (ASCII flat file), the XML schema specifications, and the SQL encoding specifications. These specifications support the explicit registration of updated information, thereby allowing map databases to continue to reflect ground truth over time.

Features, Attributes and Relationships appear in the physical GDF as codes. These codes are specified in Annex A. Codes used in the metadata are given in Annex B, which is an informative part of this International Standard. In order to access the most up-to-date information, the user is referred to the original source organization. Annex C contains the specification of Features of the theme Services as an informative part of this International Standard. In Annex D, the syntax for specifying temporal aspects of geographic information is described. The specific rules for organizing GDF in different spatial subdivisions (Sections) is described in Annex E. As informative parts of this International Standard, guidelines for the formation of Level 2 Features from the Feature Theme Roads and Ferries are given in Annex F. A list of local Administrative Area names in different countries is provided in Annex G, as well as illustrative examples for the description of the (non-hierarchical) geopolitical structures and their components in a number of countries. Finally, the use of notation and phonetic Attributes for character strings are illustrated in the informative Annex H. Annex H provides a range of examples showing how the different notation- and phoneme-related Attribute properties can be used to qualify name strings, in both their written and their pronounced form.

Intelligent transport systems — Geographic Data Files (GDF) — GDF5.0

IMPORTANT — The colours represented in the electronic file of this document can be neither viewed on screen nor printed as true representations. For the purposes of colour matching, see ISO 3864-1 which provides colorimetric and photometric properties together with, as a guideline, references from colour order systems.

1 Scope

This International Standard specifies the conceptual and logical data model and physical encoding formats for geographic databases for Intelligent Transport Systems (ITS) applications and services. It includes a specification of potential contents of such databases (data dictionaries for Features, Attributes and Relationships), a specification of how these contents shall be represented, and of how relevant information about the database itself can be specified (metadata).

The focus of this International Standard is on ITS applications and services and it emphasizes road and road-related information. ITS applications and services, however, also require information in addition to road and road-related information.

EXAMPLE 1 ITS applications and services need information about addressing systems in order to specify locations and/or destinations. Consequently, information about the administrative and postal subdivisions of an area is essential.

EXAMPLE 2 Map display is an important component of ITS applications and services. For proper map display, the inclusion of contextual information such as land and water cover is essential.

EXAMPLE 3 Point-of-Interest (POI) or service information is a key feature of traveller information. It adds value to end-user ITS applications and services.

Typical ITS applications and services targeted by this International Standard are in-vehicle or portable navigation systems, traffic management centres, or services linked with road management systems, including the public transport systems.

The Conceptual Data Model has a broader focus than ITS applications and services. It is application independent, allowing for future harmonization of this International Standard with other geographic database standards.

2 Normative references

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

ISO 690, *Information and documentation — Guidelines for bibliographic references and citations to information resources*

ISO 3166-1, *Codes for the representation of names of countries and their subdivisions — Part 1: Country codes*. Codes are available at http://unstats.un.org/unsd/methods/m49/m49alpha.htm

3 Terms and definitions

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

3.1 General terms

3.1.1
cartographic primitive
atomic construction element in a cartographic representation, i.e. Node, Edge and Face

3.1.2
data file
collection of related data records having a homogeneous structure

NOTE See Reference [34].

3.1.3
data record
record containing Feature-related data

3.1.4
global record
record that logically precedes the data records and contains control parameters, data definition and documentation necessary to interpret companion data records

NOTE See Reference [25].

3.1.5
Medium Unit
object for data storage that can be considered as a physically undivided whole

EXAMPLE One floppy disk, one magnetic tape, a CD, or a DVD.

3.1.6
multi-media
any kind of data other than conventional data

EXAMPLE Graphic, audio or visual data.

3.1.7
Multi-media Object
piece of multi-media to be processed by an application

EXAMPLE A picture, a text, a movie, or a sound.

3.1.8
repeating Attribute Type
Attribute Type that may have multiple values associated to one and the same instance of a particular Feature Class

3.1.9
Spatial Domain
description of the limits of a geographical area to which a particular set of data belongs spatially

3.1.10
source material
origin of data in analogue or digital representation, stored on any kind of data medium

3.1.11
topology
field of mathematics that deals with characteristics of geometric structures that are preserved after continual variation

NOTE See Reference [43].

3.1.12
transcription
rendering of geographic names from a non-alphabetic script into an alphabetic one or vice versa

NOTE 1 See Reference [40].

NOTE 2 The term is also applied to initial recording in script of hitherto unwritten names.

3.2 Mathematical terms

3.2.1
Area Feature
two-dimensional Feature, defined by one or more Faces

3.2.2
Edge
directed sequence of non-intersecting Line Segments with Nodes at each end

NOTE See Reference [34].

3.2.3
enclave
small part of an area enclosed by another area, seen from the area to which that part belongs

3.2.4
exclave
small part of an area enclosed by another area, seen from the enclosing area

3.2.5
Face
two-dimensional element bounded by a closed sequence of Edges and by zero or more sets of non-intersecting closed sequences of Edges within the first sequence of Edges

NOTE The Face is the atomic two-dimensional element.

3.2.6
graph
set of points and a set of arrows, with each arrow joining one point to another, whereby the points are called Nodes of the graph, and the arrows are called the Edges of the graph

NOTE See Reference [34].

3.2.7
Intermediate Point
point, other than a Node, that defines the shape of an Edge

3.2.8
Line Feature
one-dimensional Feature defined as a sequence of one or more Edges

3.2.9
Node
zero-dimensional element that is a topological junction of two or more Edges, or an end point of an Edge

NOTE See Reference [34].

3.2.10
non-planar graph
graph which cannot be embedded in a plane

3.2.11
planar graph
graph which can be embedded in a plane, meaning that it can be drawn on the plane so that Edges intersect only at a Node mutually incident with them

3.2.12
point
zero-dimensional element that specifies geometric location specified by one coordinate pair or triplet

NOTE See Reference [34].

3.2.13
Line Segment
Segment
direct connection between two Intermediate Points, two Nodes or a Node and an Intermediate Point

3.2.14
valency
degree
number of Edges which are incident with a particular Node

3.3 Geodetical terms

3.3.1
control point
point having known coordinates in the real world and identifiable with a corresponding point in a map or an aerial photograph or satellite image

3.3.2
ellipsoidal height
distance between a point and the reference ellipsoid, measured along the ellipsoidal normal

3.3.3
geodetic datum
mathematical surface that approximates a portion of the earth's surface

3.3.4
geoid
model of the figure of the earth, that coincides with the mean sea level over the oceans and continues in continental areas as an imaginary sea level surface, defined by spirit level

NOTE At every place, geoid level/surface is perpendicular to the pull of gravity. The shape is irregular but can, for most purposes, be approximated by an oblate ellipsoid.

3.3.5
Geoid Undulation
difference between the orthometric height and the ellipsoidal height, measured along the ellipsoid normal

3.3.6
height
elevation
(vertical) distance between a point and the reference height level or the reference ellipsoid

NOTE On land maps, the reference level is commonly the mean sea level.

3.3.7
horizontal reference system
reference system for positions

3.3.8
magnetic declination
angle between Magnetic North and True North

NOTE See Reference [40].

3.3.9
map projection
transformation method used to represent the curved earth surface on a plane

3.3.10
offset
pair of values subtracted from all coordinate values in order to shorten these coordinate values

3.3.11
orthometric height
distance between a point and the geoid, measured along the perpendicular line

3.3.12
reference ellipsoid
oblate ellipsoid of revolution that is used to approximate the figure of the geoid

NOTE It is specified by two parameters: a semi-major axis a (equatorial radius of the earth) and a semi-minor axis b (polar radius). The flattening f is defined as: $f = (a - b)a$.

3.3.13
reference height level
level to which all terrestrial heights are referred

NOTE It changes from country to country and it forms part of the national coordinate system for surveying and mapping.

3.3.14
reference system
coordinate system on which a national survey is based

NOTE See Reference [40].

3.3.15
vertical reference system
reference system for elevations

3.3.16
world geodetic system
WGS
set of standard reference ellipsoids that define latitude, longitude and height for every point on the earth

3.4 GDF terms

NOTE All Feature Classes mentioned below are defined in the Feature Catalogue.

3.4.1
Album
collection of related Datasets (logical sub-division) and, if applicable, Volumes (physical sub-division)

3.4.2
Attribute
characteristic of a Feature which is independent of other Features

NOTE See Reference [34].

3.4.3
Attribute Code
alphanumeric identifier for an Attribute Type

NOTE See Reference [57].

3.4.4
Attribute Name
name associated to an Attribute Type

NOTE See Reference [57].

3.4.5
Attribute Type
defined characteristic of a Feature, which is independent of the other Features

3.4.6
Attribute Value
specific quality or quantity assigned to an Attribute

NOTE See Reference [34].

3.4.7
Dataset
sub-division of Album, which in turn can be sub-divided into Sections

NOTE A large set of data covering a particular geographic area can be considered a Dataset.

3.4.8
District
area regarded as a geographical unit, which is defined by the delivery of a specific public or private sector service

3.4.9
Feature
database representation of a real world object

3.4.10
Feature Category
type of representation of a Feature, including Point, Line, Area and Complex Feature

3.4.11
Feature Class
categorization of a Feature

3.4.12
Feature Class Code
alphanumeric identifier for a Feature Class

NOTE See Reference [57].

3.4.13
Feature Name
name associated with a Feature Class

NOTE See Reference [34].

3.4.14
Feature Theme
specified group of related Features

3.4.15
field
set of characters representing one unit of data

3.4.16
Layer
certain subset of a Dataset based upon information contents

3.4.17
Manoeuvre
ordered sequence of a Road Element, a Junction and one or more Road Elements, and optionally associated with a Traffic Sign

3.4.18
Place
administrative area of the types: Order-i Area, Country, Supra-National Area, Administrative Place A-Z or Named Area Feature of the types: Built-up Area, Named Area, District

3.4.19
Property
combination of Attribute and Relationship values which pertain to a Feature and which together define a certain characteristic of the Feature

3.4.20
Relationship Code
alphanumerical identifier for a Relationship

3.4.21
Relationship name
name associated with a Relationship Type

NOTE See Reference [34].

3.4.22
Relationship Type
defined characteristic of a Feature which is dependent on other Features

3.4.23
Semantic Relationship
Relationship
characteristic of a Feature involving other Features