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**Intelligente Verkehrssysteme –
Geografische Datendateien (GDF) GDF5.1 –
Teil 1: Anwendungsunabhängige Kartendaten, die zwischen verschiedenen
Quellen geteilt werden (ISO 20524-1:2020);
Englische Fassung EN ISO 20524-1:2022**

Intelligent transport systems –
Geographic Data Files (GDF) GDF5.1 –
Part 1: Application independent map data shared between multiple sources
(ISO 20524-1:2020);
English version EN ISO 20524-1:2022

Systèmes de transport intelligents –
Fichiers de données géographiques (GDF) GDF5.1 –
Partie 1: Données cartographiques partagées entre sources multiples et indépendantes des
applications (ISO 20524-1:2020);
Version anglaise EN ISO 20524-1:2022

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Nationales Vorwort

Dieses Dokument (EN ISO 20524-1:2022) wurde vom Technischen Komitee ISO/TC 204 „Intelligent transport systems“ in Zusammenarbeit mit dem Technischen Komitee CEN/TC 278 „Intelligente Verkehrssysteme“, dessen Sekretariat von NEN (Niederlande) gehalten wird, erarbeitet.

Das zuständige deutsche Normungsgremium ist der Gemeinschaftsarbeitsausschuss NA 052-00-71 GA „Gemeinschaftsarbeitsausschuss NAAutomobil/DKE: Intelligente Verkehrssysteme“ im DIN-Normenausschuss Automobiltechnik (NAAutomobil).

Dieses Dokument enthält unter Berücksichtigung des DIN-Präsidialbeschlusses 1/2004 nur die Englische Fassung von EN ISO 20524-1:2022.

Für die in diesem Dokument zitierten Dokumente wird im Folgenden auf die entsprechenden deutschen Dokumente hingewiesen:

ISO 690	siehe	DIN ISO 690
ISO 2108	siehe	DIN ISO 2108
ISO 3166-1	siehe	DIN EN ISO 3166-1
ISO 6709	siehe	DIN EN ISO 6709
ISO 19115-1	siehe	DIN EN ISO 19115-1
ISO 19148	siehe	DIN EN ISO 19148

GDF5.1 ist eine Weiterentwicklung von GDF5.0, welches das Konzept von „teilbaren Eigenschaften“ einführt. Dabei wurden kooperative ITS berücksichtigt und mit der Normenreihe EN 12896 (Transmodel) des öffentlichen Verkehrs harmonisiert.

Dieses Dokument repräsentiert den ersten Teil der Spezifikation GDF5.1. Das Dokument legt das übergeordnete konzeptuelle Datenmodell fest. Darin werden die grundlegenden GDF-Bausteine und deren Wechselbeziehungen erklärt. Das Dokument beinhaltet weiterhin eine Spezifikation unterschiedlicher Topologie-Arten, die von diesem Dokument unterstützt werden. Außerdem wird beschrieben, wie Datenbankdarstellungen realer Objekte, bezogen auf deren Eigenschaften, festgelegt sind. Es werden die Charakteristiken von Eigenschaften, auch Attribute genannt, beschrieben, sowie die topologischen und nicht-topologischen Wechselbeziehungen zwischen Eigenschaften. Schlussendlich werden die Anordnung der Eigenschaften in GDF beschrieben.

Aktuelle Informationen zu diesem Dokument können über die Internetseiten von DIN (www.din.de) durch eine Suche nach der Dokumentennummer aufgerufen werden.

Änderungen

Gegenüber DIN EN ISO 14825:2011-10 wurden folgende Änderungen vorgenommen:

- a) die GDF5.1-Spezifikation wurde übernommen;
- b) Einträge zum öffentlichen Verkehr wurden gelöscht;
- c) veraltete Bilder wurden an GDF5.1-Anforderungen angepasst.

Frühere Ausgaben

DIN EN ISO 14825: 2005-11, 2011-10

Nationaler Anhang NA (informativ)

Begriffe

Reihenfolge und Inhalt der folgenden Begriffe sind identisch mit denen im Abschnitt Begriffe der Englischen Fassung.

Für die Anwendung dieses Dokuments gelten die folgenden Begriffe.

ISO und IEC stellen terminologische Datenbanken für die Verwendung in der Normung unter den folgenden Adressen bereit:

- ISO Online Browsing Platform: verfügbar unter <https://www.iso.org/obp>
- IEC Electropedia: verfügbar unter <https://www.electropedia.org/>

3.1 Allgemeine Begriffe

3.1.1

kartographisches Primitiv

en **cartographic primitive**

atomares Konstruktionselement in kartographischer Darstellung

BEISPIEL Knoten, Kante, Fläche.

3.1.2

Datendatei

en **data file**

Sammlungbezogener Datenaufzeichnungen, die eine homogene Struktur haben

Anmerkung 1 zum Begriff: Siehe Verweisung [1].

3.1.3

Datenaufzeichnung

en **data record**

Aufzeichnung, die eigenschaftsrelevante Daten beinhaltet

3.1.4

allgemeine Aufzeichnung

en **global record**

Aufzeichnung, die den Datensätzen logisch vorangestellt ist und Kontrollparameter, Datenfestlegungen und Dokumentationen beinhaltet, die notwendig sind, um begleitende Datenaufzeichnungen zu interpretieren

Anmerkung 1 zum Begriff: Siehe Verweisung [2].

3.1.5

Medieneinheit

en **Medium Unit**

Datenspeicherobjekt, das als physikalisch ungeteiltes Ganzes angesehen werden kann

BEISPIEL Eine Diskette, ein Tonband, eine CD oder eine DVD.

3.1.6

Multimedia

en **multi-media**

jede Art von Daten, die keine konventionelle Daten sind

BEISPIEL Grafische, Audio- oder visuelle Daten.

3.1.7

Multimedia-Objekt

en **Multi-media Object**

multimedialer Teil, der von einer Anwendung verarbeitet wird

BEISPIEL Ein Bild, ein Text, ein Film oder ein Ton.

3.1.8

wiederholender Attributstyp

en **repeating Attribute Type**

Attributstyp, der verschiedene Werte bezogen auf dieselbe Instanz einer bestimmten Eigenschaftsgruppe haben darf

3.1.9

räumliche Domain

en **Spatial Domain**

Beschreibung von Grenzen eines geografischen Bereichs, dem eine bestimmte Menge von Daten räumlich dazugehört

3.1.10

Quellenmaterial

en **source material**

Datenquellen in analoger oder digitaler Darstellung, die auf einem beliebigen Datenträger gespeichert sind

3.1.11

Topologie

en **topology**

mathematisches Feld, das sich mit den Charakteristiken geometrischer Strukturen beschäftigt, die nach fortlaufender Veränderung erhalten bleiben

Anmerkung 1 zum Begriff: Siehe Verweisung [3].

3.1.12

Umschreibung

en **transcription**

Übersetzung geografischer Namen aus nicht-alphabetischer Schrift in eine alphabetische oder umgekehrt

Anmerkung 1 zum Begriff: Siehe Verweisung [4].

Anmerkung 2 zum Begriff: Der Begriff wird außerdem zur ersten schriftlichen Aufzeichnung von bisher ungeschriebenen Namen angewendet.

3.2 Mathematische Begriffe

3.2.1

Gebietseigenschaft

en **Area Feature**

zweidimensionale Eigenschaft, die von einer oder mehreren Fläche(n) festgelegt ist

3.2.2**Kante**en **Edge**

direkte Sequenz von sich nicht überschneidenden Liniensegmenten mit Knoten an jedem Ende

Anmerkung 1 zum Begriff: Siehe Verweisung [1].

3.2.3**Enklave**en **enclave**

kleiner Gebietsteil, der von einem anderen Gebiet umschlossen ist von dem Gebiet aus gesehen, zu dem der Teil gehört

3.2.4**Exklave**en **exclave**

kleiner Gebietsteil, der von einem anderen Gebiet umschlossen ist von dem umschließenden Gebiet aus gesehen

3.2.5**Fläche**en **face**

zweidimensionales Element, das von einer geschlossenen Sequenz von Kanten und von keiner oder mehreren Menge(n) sich nicht überschneidenden geschlossenen Sequenzen von Kanten innerhalb der ersten Sequenz von Kanten, begrenzt ist

Anmerkung 1 zum Begriff: Die Fläche ist das kleinste zweidimensionale Element.

3.2.6**Graph**

Menge von Punkten und eine Menge von Pfeilen, bei der jeder Pfeil einen Punkt mit dem anderen verbindet, wobei die Punkte die Knoten des Graphen und die Pfeile die Kanten des Graphen genannt werden

Anmerkung 1 zum Begriff: Siehe Verweisung [1].

3.2.7**Zwischenpunkt**en **Intermediate Point**

Punkt, der kein Knoten ist, und die Form einer Kante festlegt

3.2.8**Linieeigenschaft**en **Line Feature**

eindimensionale Eigenschaft, die als Sequenz von einer oder mehreren Kante(n) festgelegt ist

3.2.9**Knoten**en **Node**

nulldimensionales Element als topologische Verbindung von zwei oder mehreren Kanten oder eines Endpunktes einer Kante

Anmerkung 1 zum Begriff: Siehe Verweisung [1].

3.2.10

nicht-planarer Graph

en **non-planar graph**

Graph, der nicht in einer Ebene eingebettet werden kann

3.2.11

planarer Graph

en **planar graph**

Graph, der in einer Ebene eingebettet werden kann, d. h. dass dieser auf einer Ebene gezeichnet ist, sodass sich die Kanten nur an einem Knoten schneiden, an dem sie sich gegenseitig berühren

3.2.12

Punkt

en **point**

nulldimensionales Element, das den geometrischen Ort angibt, der durch ein Koordinatenpaar oder drei Koordinaten festgelegt wird

Anmerkung 1 zum Begriff: Siehe Verweisung [1].

3.2.13

Liniensegment

Segment

en **line segment**

segment

direkte Verbindung zwischen zwei Zwischenpunkten, zwei Knoten oder einem Knoten und einem Zwischenknoten

3.2.14

Wertigkeit

Grad

en **valency**

degree

Anzahl von Kanten, die mit einem bestimmten Knoten verbunden sind

3.3 Geodätische Begriffe

3.3.1

Kontrollpunkt

en **control point**

Punkt mit bekannten realen Welt-Koordinaten, der mit einem korrespondierenden Punkt in einer Karte oder einer fotografischen Gebiets- oder Satellitenaufnahme identifizierbar ist

3.3.2

ellipsoidische Höhe

en **ellipsoidal height**

Abstand zwischen einem Punkt und dem Referenz-Ellipsoid, gemessen entlang der ellipsoidischen Normalen

3.3.3

geodätisches Datum

en **geodetic datum**

mathematische Oberfläche, die sich an einen Teil der Erdoberfläche annähert

3.3.4**Geoid**

Modell der Erdform, welches sich mit dem mittleren Meeresspiegel über die Ozeane deckt und sich in kontinentalen Gebieten als imaginäre Meeresspiegeloberfläche, mit Nivellierwaage definiert, fortsetzt

Anmerkung 1 zum Begriff: An jedem Platz ist das Geoid-Niveau/die Geoid-Oberfläche senkrecht zur Gravitationskraft. Die Form ist unregelmäßig, aber kann, für die meisten Zwecke, als abgeflachtes Ellipsoid angenähert werden.

3.3.5**Geoid-Welligkeit**

en **Geoid Undulation**

Unterschied zwischen der Meereshöhe und der ellipsoidischen Höhe, gemessen entlang der ellipsoidischen Normalen

3.3.6**Höhe****Erhöhung**

en **height**

elevation

(vertikaler) Abstand zwischen einem Punkt und dem Referenzhöheniveau oder des Referenz-Ellipsoiden

Anmerkung 1 zum Begriff: Auf Landkarten ist das Referenzniveau der mittlere Meeresspiegel.

3.3.7**horizontales Referenzsystem**

en **horizontal reference system**

Referenzsystem für Positionen

3.3.8**magnetische Missweisung**

en **magnetic declination**

Winkel zwischen dem magnetischen und dem echten Nordpol

Anmerkung 1 zum Begriff: Siehe Verweisung [4].

3.3.9**Kartenprojektion**

en **map projection**

Transformationsmethode, die dafür verwendet wird, die gewölbte Erdoberfläche auf einer Ebene darzustellen

3.3.10**Offset**

Wertepaar, das von allen Koordinatenwerten abgezogen wird, um diese Koordinatenwerte zu kürzen

3.3.11**Meereshöhe**

en **orthometric height**

Abstand zwischen einem Punkt und dem Geoid, gemessen entlang der senkrechten Linie

3.3.12**Referenz-Ellipsoid**

en **reference ellipsoid**

abgeflachtes rotierendes Ellipsoid, das verwendet wird, sich dem Geoidkörper anzunähern

Anmerkung 1 zum Begriff: Es wird durch zwei Parameter festgelegt: eine große Halbachse a (äquatorialer Radius der Erde) und eine kleine Halbachse b (Polarradius). Die Abplattung f ist folgendermaßen festgelegt: $f = (a - b)/a$.

3.3.13

Referenz-Höhenniveau

en **reference height level**

Niveau, auf das sich alle terrestrischen Höhen beziehen

Anmerkung 1 zum Begriff: Dies ändert sich von Land zu Land und bildet Teile des nationalen Koordinatensystems für die Landvermessung und das Kartographieren.

3.3.14

Referenzsystem

en **reference system**

Koordinatensystem basierend auf einer nationalen Landvermessung

Anmerkung 1 zum Begriff: Siehe Verweisung [4].

3.3.15

vertikales Referenzsystem

en **vertical reference system**

Referenzsystem für Erhebungen

3.3.16

geodätisches Bezugssystem

WGS, en: world geodetic system

Menge von standardisierten Referenz-Ellipsoiden, die Breitengrad, Längengrad und Höhe für jeden Punkt auf der Erde festlegen

3.4 GDF-Begriffe

ANMERKUNG Alle unten erwähnten Eigenschaftsklassen sind im Eigenschaftskatalog festgelegt.

3.4.1

Album

Sammlung zusammengehöriger Datenmengen (logische Unterteilung) und, falls vorhanden, Inhalte (physikalische Unterteilung)

3.4.2

Attribut

en **Attribute**

Charakteristik einer Eigenschaft, die von anderen Eigenschaften unabhängig ist

Anmerkung 1 zum Begriff: Siehe Verweisung [1].

3.4.3

Attributskodierung

en **Attribute Code**

alphanumerischer Bezeichner eines Attribut-Typs

Anmerkung 1 zum Begriff: Siehe Verweisung [5].

3.4.4

Attributsname

en **Attribute Name**

zugeordneter Name für einen Attributstyp

Anmerkung 1 zum Begriff: Siehe Verweisung [5].

3.4.5**Attributstyp**en **Attribute Type**

festgelegte Charakteristik einer Eigenschaft, die von anderen Eigenschaften unabhängig ist

3.4.6**Attributswert**en **Attribute Value**

spezifische Qualität oder Quantität, die einem Attribut zugeordnet ist

Anmerkung 1 zum Begriff: Siehe Verweisung [1].

3.4.7**Datenmenge**en **Dataset**

Unterteilung eines Albums, welches wiederum in Sektionen unterteilt sein kann

Anmerkung 1 zum Begriff: Eine große Datenmenge, die einen bestimmten geografischen Bereich abdeckt, kann als Datenmenge betrachtet werden.

3.4.8**Bezirk**en **District**

als geografische Einheit betrachteter Bereich, der durch die Übermittlung eines spezifischen öffentlichen oder privaten Abschnittsdiensts festgelegt ist

3.4.9**Eigenschaft**en **Feature**

Datenbankdarstellung eines Objekts in der realen Welt

3.4.10**Eigenschaftskategorie**en **Feature Category**

Art der Darstellung einer Eigenschaft, einschließlich Punkt, Linie, Bereich und komplexe Eigenschaft

3.4.11**Eigenschaftsklasse**en **Feature Class**

Kategorisierung einer Eigenschaft

3.4.12**Eigenschaftsklassenkodierung**en **Feature Class Code**

alphanumerischer Bezeichner einer Eigenschaftsklasse

Anmerkung 1 zum Begriff: Siehe Verweisung [5].

3.4.13**Eigenschaftsname**en **Feature Name**

Name bezogen auf eine Eigenschaftsklasse

Anmerkung 1 zum Begriff: Siehe Verweisung [1].

3.4.14

Eigenschaftsthema

en **Feature Theme**

festgelegte Gruppe zusammengehörender Eigenschaften

3.4.15

Feld

en **field**

Menge von Charakteristiken, die eine Dateneinheit darstellt

3.4.16

Schicht

en **Layer**

gewisse Untermenge einer Datenmenge, die auf Informationsinhalten basiert

3.4.17

Manöver

en **Manoeuvre**

geordnete Sequenz eines Straßenelements, eines Abzweigs und eines oder mehrerer Straßenelementen und optional mit einem Straßenschild verbunden

3.4.18

Platz

en **Place**

administrativer Bereich der Typen: Order-I-Bereich, Land, staatenübergreifender Bereich, administrativer Platz A-Z, oder benannte Gebietseigenschaft der Typen: bebauter Bereich, benannter Bereich, Bezirk

3.4.19

Besitz

en **Property**

Kombination von Attributs- und Beziehungswerten, die eine Eigenschaft betreffen und die zusammen eine gewisse Charakteristik der Eigenschaft festlegen

3.4.20

Beziehungskodierung

en **Relationship Code**

alphanumerischer Bezeichner für eine Beziehung

3.4.21

Beziehungsname

en **Relationship Name**

Name, der einem Beziehungstyp zugeordnet ist

Anmerkung 1 zum Begriff: Siehe Verweisung [1].

3.4.22

Beziehungstyp

en **Relationship Type**

festgelegte Charakteristik einer Eigenschaft, die von anderen Eigenschaften abhängig ist

3.4.23

semantische Beziehung

Beziehung

en **Semantic Relationship**

Relationship

Charakteristik einer Eigenschaft, die weitere Eigenschaften einbezieht

3.4.24**Abschnitt**
en **Section**

räumliche Untermenge einer Datenmenge

Anmerkung 1 zum Begriff: Der Überdeckungsbereich eines Kartenblattes, der durch geografische Koordinaten begrenzt ist, kann als Abschnitt betrachtet werden.

3.4.25**Verkehrselement**
en **Transportation Element**

Straßenelement, Weg, Eisenbahnelement, Pfad, Fährverbindung, Wasserkörper, Wasserbegrenzungselement, Abzweig, Eisenbahnelement-Abzweig oder Wasserbegrenzungsabzweig

3.4.26**Wendepunkt**
en **turn**

geordnete Sequenz eines Straßenelements, eines Abzweigs und eines Straßenelements

Anmerkung 1 zum Begriff: Ein Wendepunkt ist ein Spezialfall eines Manövers bezogen auf genau zwei Straßenelemente.

3.4.27**Datenträger**
en **Volume**

kleinste physikalische Einheit eines Mediums

Anmerkung 1 zum Begriff: Ein einzelner Raum kann eine oder mehrere GDF-Datenmenge(n), abhängig von der Größe der Datenmenge, beinhalten.

BEISPIEL Ein Tonband, eine Diskette.

Nationaler Anhang NB (informativ)

Literaturhinweise

DIN ISO 690, *Information und Dokumentation — Richtlinien für Titelangaben und Zitierung von Informationsressourcen*

DIN ISO 2108, *Information und Dokumentation — Internationale Standard-Buchnummer (ISBN)*

DIN EN ISO 3166-1, *Codes für die Namen von Ländern und deren Untereinheiten — Teil 1: Codes für Ländernamen*

DIN EN ISO 6709, *Standarddarstellung für geographische Punkte durch Koordinaten*

DIN EN ISO 19115-1, *Geoinformation — Metadaten — Teil 1: Grundsätze*

DIN EN ISO 19148, *Geoinformation — Lineares Bezugssystem*

English Version

Intelligent transport systems - Geographic Data Files
(GDF) GDF5.1 - Part 1: Application independent map data
shared between multiple sources (ISO 20524-1:2020)

Systèmes de transport intelligents - Fichiers de
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Intelligente Verkehrssysteme - Geografische
Datendateien (GDF) GDF5.1 -
Teil 1: Anwendungsunabhängige Kartendaten, die
zwischen verschiedenen Quellen geteilt werden
(ISO 20524-1:2020)

This European Standard was approved by CEN on 20 December 2022.

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COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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European foreword

The text of ISO 20524-1:2020 has been prepared by Technical Committee ISO/TC 204 "Intelligent transport systems" of the International Organization for Standardization (ISO) and has been taken over as EN ISO 20524-1:2022 by Technical Committee CEN/TC 278 "Intelligent transport systems" the secretariat of which is held by NEN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 2023, and conflicting national standards shall be withdrawn at the latest by June 2023.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN ISO 14825:2011.

Any feedback and questions on this document should be directed to the users' national standards body. A complete listing of these bodies can be found on the CEN website.

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Endorsement notice

The text of ISO 20524-1:2020 has been approved by CEN as EN ISO 20524-1:2022 without any modification.

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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).

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

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

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

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

A list of all parts in the ISO 20524 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

GDF5.1 (the ISO 20524 series) is an evolution of GDF5.0 that introduces the concept of Sharable Features, takes cooperative ITS (Cooperative ITS) needs into account and is harmonized with the European public transportation standard EN 12896:2012 (TRANSMODEL). This last harmonization was made in the framework of the European Opticities project.

GDF5.1 consists of two parts:

- GDF5.1 Part 1 (this document) contains GDF5.0 specification except Public Transport Theme specification which has been revised and is now described in Part 2.
- GDF5.1 Part 2 (ISO 20524-2) is dedicated to Sharable Features, Cooperative ITS and Public Transport.

This document presents the specification for GDF5.1 Part 1. GDF5.0 entities are unchanged but Public Transport Theme entities have been removed and corresponding sections and figures are deprecated and refer to GDF5.1 Part 2 (ISO 20524-2). In order to ensure the consistency between GDF5.0 and GDF5.1 Part 1 (this document), the numbering of common figures in both versions has been conserved. GDF5.1 Part 1 (this document) 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 document. 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 document 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 document (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 have been defined. Relationships may 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 may be represented are specified for each topology type. This document 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 document since this is considered to be an issue between clients and vendors. This document 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, e.g. character sets, projection systems. It is important that all of 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 document 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 document 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.

Two physical implementations for data exchange and delivery are specified: the Media Record Specifications (ASCII flat file) and the XML schema specifications. These physical implementations are limited to the data specification present in GDF5.1 Part 1 (this document).

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 document. 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 document. 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 document, 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 may be used to qualify name strings, in both their written and their pronounced form.

Intelligent transport systems — Geographic Data Files (GDF) GDF5.1 —

Part 1:

Application independent map data shared between multiple sources

1 Scope

This document 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 may be specified (metadata).

The focus of this document 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 document are in-vehicle or portable navigation systems, traffic management centres, or services linked with road management systems, including 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 document with other geographic database standards.

2 Normative references

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

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

ISO 639-2, *Codes for the representation of names of languages — Part 2: Alpha-3 code*

NOTE 1 Codes are available at <http://www.loc.gov/standards/iso639-2/>

ISO 3166-1, *Codes for the representation of names of countries and their subdivisions — Part 1: Country codes*

NOTE 2 Codes are available at <https://www.iso.org/obp/ui>

3 Terms and definitions

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

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

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

3.1 General terms

3.1.1

cartographic primitive

atomic construction element in a cartographic representation

EXAMPLES Node, Edge and Face.

3.1.2

data file

collection of related data records having a homogeneous structure

Note 1 to entry See Reference [1].

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 1 to entry See Reference [2].

3.1.5

Medium Unit

object for data storage that may 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 Graphical, 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 1 to entry See Reference [3].

3.1.12

transcription

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

Note 1 to entry See Reference [4].

Note 2 to entry 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 1 to entry See Reference [1].

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 1 to entry 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 1 to entry See Reference [1].

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 1 to entry See Reference [1].

3.2.10

non-planar graph

graph which may not be embedded in a plane

3.2.11

planar graph

graph which may be embedded in a plane, i.e. it may 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 1 to entry See Reference [1].

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, 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 1 to entry At every place, geoid level/surface is perpendicular to the pull of gravity. The shape is irregular but may, 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 1 to entry 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 1 to entry See Reference [4].

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 1 to entry 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 1 to entry 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 1 to entry See Reference [4].

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 1 to entry See Reference [1].

3.4.3

Attribute Code

alphanumeric identifier for an Attribute Type

Note 1 to entry See Reference [5].

3.4.4

Attribute Name

name associated to an Attribute Type

Note 1 to entry See Reference [5].

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 1 to entry See Reference [1].

3.4.7

Dataset

sub-division of Album, which in turn may be sub-divided into Sections

Note 1 to entry A large set of data covering a particular geographic area may 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 1 to entry See Reference [5].

3.4.13

Feature Name

name associated with a Feature Class

Note 1 to entry See Reference [1].

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 1 to entry See Reference [1].

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

3.4.24

Section

spatial subset of a Dataset

Note 1 to entry The coverage area of a map sheet, confined by geographic coordinates, may be considered a Section.

3.4.25

Transportation Element

Road Element, Pathway, Railway Element, Path, Ferry Connection, Water Body, Water Boundary Element, Junction, Railway Element Junction or Water Boundary Junction

3.4.26

turn

ordered sequence of a Road Element, a Junction and a Road Element

Note 1 to entry A turn is a special case of a Manoeuvre, relating exactly two Road Elements.

3.4.27

Volume

smallest physical unit of a medium

Note 1 to entry A single Volume may contain one or more GDF Datasets depending on Dataset size.

EXAMPLE A magnetic tape, a floppy disk.

4 Symbolization and notation elements

Many of the basic concepts of GDF are best expressed diagrammatically in data models. The Unified Modeling Language (UML) [6] has been adopted as the conceptual modeling language for GDF.

Annex I provides a summary of the UML Class Diagram notation conventions used in this document.

5 Overall conceptual data model

5.1 Conceptual data models in GDF

The general data model of GDF is presented in Figure 1 and Figure 2, Figure 4 through Figure 8, and Figure 10 through Figure 18. Detailed sub-schemas are presented in the respective clauses. The data model diagrams convey a range of dedicated terms describing concepts of the GDF model; according to UML practise, these terms are spelled using "CamelCase" notation. Textual descriptions complementing the graphical descriptions use initial capitals for each constituent word of a given GDF term.

The general data model—serving as meta-model for the respective semantic models of the individual Feature classes (see Feature Catalogue), of the individual Attribute types (see Attribute Catalogue), and of the individual Relationship Types (see Relationship Catalogue)—are presented and explained in detail in the remainder of this clause. Each Feature class, Attribute type, and Relationship Type may be considered an instance of the generic UML classes for Feature class, Attribute type, and Relationship Type, respectively, in the meta-model. This two-level notion is implemented using UML class sub-typing.

While IDs are usually not part of a conceptual model, it has been decided to explicitly include them here due to their conceptual relevance. This refers to the fact that they provide a means of unique identification of elements regardless of a particular physical realization of the GDF conceptual model. This, despite the fact that certain physical realizations may not require the use of physical IDs. Consequently, transition between different physical realizations will not result in loss of information.

5.2 The general data model of GDF

5.2.1 The Feature model

In the centre of the model in Figure 1 resides the "Feature" which is a database representation of a real world geographic object. Examples of real world geographic objects are roads or buildings. Note that in this diagram "Feature" has the meaning of Feature instance, i.e. an individual occurrence of a geographic object, such as the Eiffel Tower in Paris.

Figure 1 shows that each Feature shall belong to exactly one Feature Class and exactly one Feature Theme. The diagram also shows that Feature Classes and Feature Themes are uniquely referenced by a name and a code.

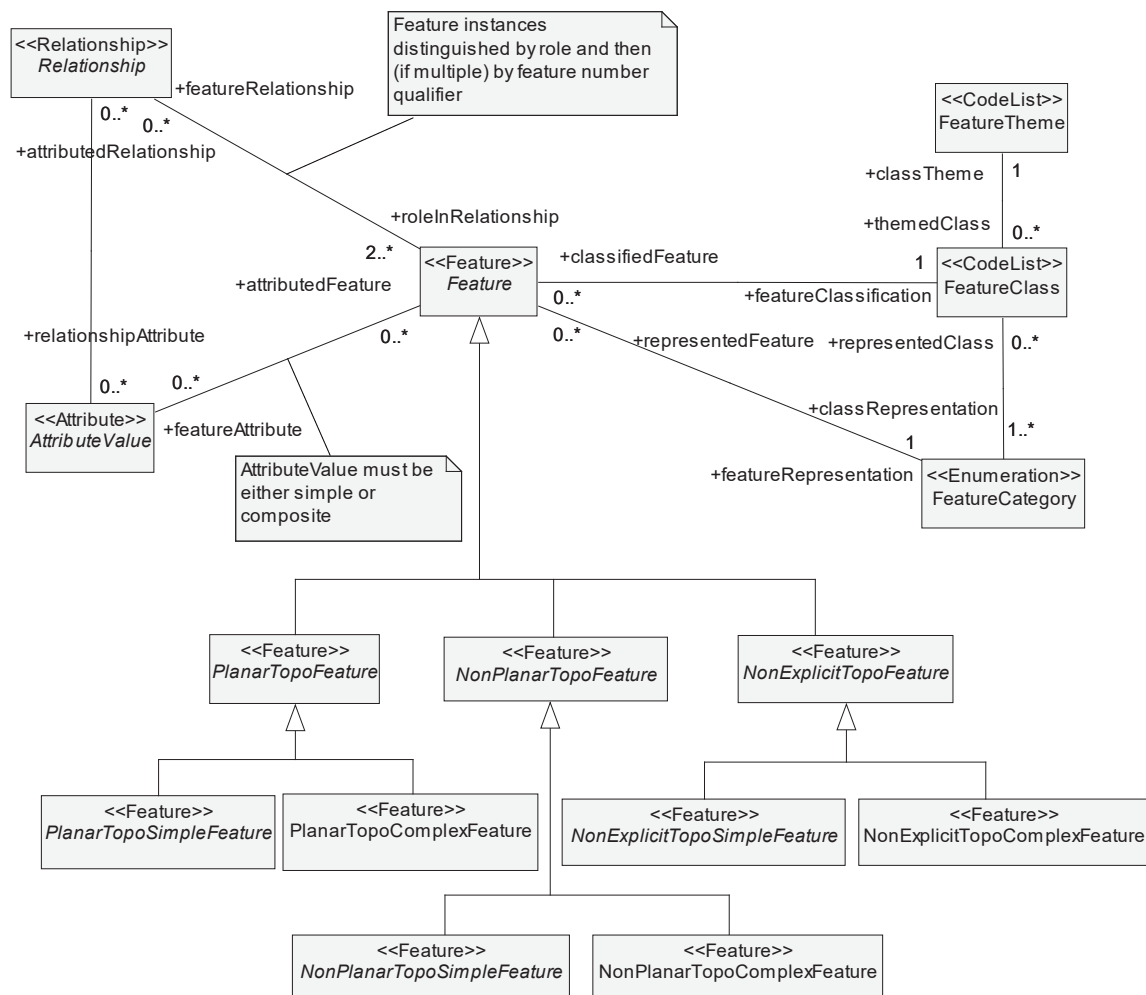


Figure 1 — Overall Conceptual Data Model

Each Feature belongs to exactly one Feature Class. This constraint is indicated in Figure 1 by the depiction of Feature Class with a multiplicity of 1 in the association between classes Feature and Feature Class. Thus, neither classless Features (Features belonging to no Feature Class) nor hybrid Features (Features belonging to multiple Feature Classes) are allowed in a GDF.

A Feature may have zero or more Attributes. Attributes serve to represent characteristics of a Feature that are independent of other Features.

A Relationship is used to associate two or more Features together. However, a Feature is not required to participate in a Relationship. A Relationship may have zero or more Attributes.

Each Feature is of exactly one Feature Category. A Feature Category is uniquely referenced by a Name and a Code. GDF defines four Feature Categories – Point, Line, Area and Complex. Collectively, Point, Line, and Area Features are referred to as Simple Features. Complex Features are aggregations of other Features, either Simple, Complex or in combination.