PD ISO/TS 19163-1:2016

BSI Standards Publication

Geographic information — Content components and encoding rules for imagery and gridded data

Part 1: Content model

bsi.

...making excellence a habit.™

Document Sharing Hub

Full document details: PD ISO/TS 19163-1:2016

National foreword

This Published Document is the UK implementation of ISO/TS 19163-1:2016.

The UK participation in its preparation was entrusted to Technical Committee IST/36, Geographic information.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

© The British Standards Institution 2016.
Published by BSI Standards Limited 2016

ISBN 978 0 580 81818 9
ICS 35.240.70

Compliance with a British Standard cannot confer immunity from legal obligations.

This Published Document was published under the authority of the Standards Policy and Strategy Committee on 31 January 2016.

Amendments/corrigenda issued since publication

Date	Text affected

Documents
Document Sharing Hub

Full document details: PD ISO/TS 19163-1:2016

TECHNICAL SPECIFICATION

ISO/TS 19163-1

First edition
2016-01-15

Geographic information — Content components and encoding rules for imagery and gridded data —

Part 1: Content model

Information géographique — Composantes de contenu et règles de codage pour l'imagerie et les données maillées —

Partie 1: Modèle de contenu

Reference number
ISO/TS 19163-1:2016(E)

Documents
Document Sharing Hub
© ISO 2016

Full document details: PD ISO/TS 19163-1:2016

COPYRIGHT PROTECTED DOCUMENT

© ISO 2016, Published in Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

© ISO 2016 – All rights reserved

Documents
Document Sharing Hub

Full document details: PD ISO/TS 19163-1:2016

Contents

Page

Foreword ... **iv**
Introduction ... **v**
1 Scope ... **1**
2 Conformance ... **1**
3 Normative references ... **1**
4 Terms and definitions ... **2**
5 Symbols and abbreviated terms ... **4**
5.1 Abbreviated terms ... 4
5.2 UML notations ... 4
6 Related International Standards ... **5**
7 Categories of imagery and gridded data ... **6**
7.1 General ... 6
7.2 Imagery ... 7
7.3 Gridded data ... 8
8 Content component models ... **8**
8.1 General ... 8
8.2 Imagery and gridded data ... 8
8.2.1 General ... 8
8.2.2 IE_ImageryAndGriddedData ... 9
8.2.3 IE_Georectified ... 9
8.2.4 IE_Georeferenceable ... 10
8.3 Thematic gridded data ... 10
8.3.1 IE_ThematicGriddedData ... 10
8.3.2 IE_CategoricalGriddedData ... 10
8.3.3 IE_NumericalGriddedData ... 10
8.4 Imagery ... 11
8.4.1 IE_Imagery ... 11
8.4.2 IE_FusedImage ... 13
8.4.3 IE_SimulatedImage ... 13
8.4.4 IE_OpticalImage ... 13
8.4.5 IE_MicrowaveData ... 13
8.4.6 IE_SARData ... 14
8.4.7 IE_RadiometerData ... 15
9 General approach for encoding (informative) ... **16**
Annex A (normative) **Abstract test suite** ... **18**
Annex B (normative) **Data dictionary of content component models** ... **21**
Bibliography ... **38**

© ISO 2016 – All rights reserved

Documents
Document Sharing Hub
Full document details: PD ISO/TS 19163-1:2016

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 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 211, *Geographic information/Geomatics*.

ISO 19163 consists of the following parts, under the general title *Geographic information — Content components and encoding rules for imagery and gridded data*:

— *Part 1: Content model* [Technical Specification]

Other parts are planned, but are not yet specified.

© ISO 2016 – All rights reserved
Documents
Document Sharing Hub
Full document details: PD ISO/TS 19163-1:2016

Introduction

Geographic imagery and gridded thematic data are widely used in the geospatial community and related fields.

A preliminary work item on imagery and gridded data components, carried out by ISO/TC 211 in 1999 to 2000, provides a summary of the conceptual classification of gridded data based on spatial and attribute properties and identifies five basic components of imagery and gridded data (ISO/TC 211 N 1017). ISO/TS 19101-2, ISO 19123 and ISO/TS 19129 specify domains and ranges of imagery, grids and coverages, and their associated relationships. ISO/TS 19129 breaks down the metadata into discovery, structural, acquisition and quality metadata. However, there are no detailed descriptions on each category and no clear associations with metadata defined in ISO 19115:2003, ISO 19115-2, ISO/TS 19130 and ISO/TS 19130-2.

Imagery is acquired by remote sensors directly or derived from source imagery. Value-added image processing can be used to derive physical properties of a remote object from images (ISO/TS 19101-2). Besides the derived images, imagery can also be integrated with other data sources to produce new gridded coverage data for a specific theme, called thematic data, which is widely used in various applications. However, the characteristics of thematic data are not covered by the existing International Standards and Technical Specifications noted above.

ISO/TS 19130 identifies the type of remote sensors by the measurand of the sensor, e.g. optical radiation, microwave energy and SONAR (acoustic) energy. Images acquired by optical sensors have different appearances and characteristics compared with those by a microwave sensor, e.g. SAR data.

The framework defined in ISO/TS 19129 describes imagery, gridded and coverage data at multiple levels, including an abstract level, a content model level and an encoding level. The first two levels combine a number of well-defined content structures in accordance with ISO 19123 and define the contents of continuous quadrilateral gridded coverages with grids of both constant and variable cell sizes. However, the content model level does not specify the necessary metadata for common understanding when integrating datasets encoded in different formats. At the encoding level, ISO/TS 19129 does not provide the explicit encoding rules for mapping content model to machine-independent encoding structure, which is crucial for the mapping and translation of images in different formats without losing information.

Based on the frameworks defined in ISO/TS 19101-2 and ISO 19123, this Technical Specification specifies the categories of imagery and gridded data and establishes a corresponding hierarchical content model. Categories of imagery and gridded data are defined based on thematic and spatial attributes and sensor types. The content model is then defined to describe the required content components of each category, including the spatial and attribute structures and the critical metadata entries as well. These metadata entries are specified as the minimum required metadata information for the purpose of common understanding. Traditionally, remote sensing data products generally have a header part and a data part. This Technical Specification describes the minimum content requirements for the header part.

For ease of implementation, this Technical Specification defines encoding rules to map the content models to XML-based encodings, following the general encoding rules defined in ISO 19118 and the encoding rules for UML-to-GML application schema defined in ISO 19136:2007, Annex E. Since GMLCOV schema (OGC 09-146r2) is optimized for handling coverages, the coverage component of the schema can be based on GMLCOV.

An increasingly large volume of image and gridded data, both natural and synthetic, is being produced because more remote sensors are becoming available. These data are encoded in diverse formats, such as GeoTIFF, BIIF, HDF-EOS, JPEG 2000, NetCDF and others as described in ISO/TR 19121. These encoding formats follow different data models, preventing them from being interoperable. In order to encode the contents defined in this Technical Specification into these data formats, ISO 19163 has been split into multiple parts with this Technical Specification defining the content components and general encoding rules and the subsequent parts defining the binding between the contents and individual physical data formats.

Documents
Document Sharing Hub

© ISO 2016 – All rights reserved

Full document details: PD ISO/TS 19163-1:2016

Geographic information — Content components and encoding rules for imagery and gridded data —

Part 1: Content model

1 Scope

This Technical Specification classifies imagery and regularly spaced gridded thematic data into types based on attribute property, sensor type and spatial property, and defines an encoding-neutral content model for the required components for each type of data. It also specifies logical data structures and the rules for encoding the content components in the structures.

The binding between the content and a specific encoding format will be defined in the subsequent parts of ISO 19163.

This Technical Specification does not address LiDAR, SONAR data and ungeoreferenced gridded data.

The logical data structures and the rules for encoding the content components will be addressed in the subsequent parts of ISO 19163.

2 Conformance

This Technical Specification standardizes the categories of imagery and regularly spaced gridded thematic data as well as their core content models. There is one conformance class for each data category. Any set of imagery and regularly spaced gridded thematic data claiming conformance to this Technical Specification shall satisfy the corresponding requirements defined in the abstract test suite in Annex A.

3 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 19103:2015, *Geographic information — Conceptual schema language*

ISO 19111, *Geographic information — Spatial referencing by coordinates*

ISO 19115-1, *Geographic information — Metadata — Part 1: Fundamentals*

ISO 19115-2[1)], *Geographic information — Metadata — Part 2: Extensions for imagery and gridded data*

ISO 19123:2005, *Geographic information — Schema for coverage geometry and functions*

ISO/TS 19101-2:2008, *Geographic information — Reference model — Part 2: Imagery*

ISO/TS 19130:2010, *Geographic information - Imagery sensor models for geopositioning*

ISO/TS 19159-1, *Geographic information — Calibration and validation of remote sensing imagery sensors and data — Part 1: Optical sensors*

1) At the publication time of this Technical Specification, only ISO 19115-2:2009, which references to ISO 19115:2003, is available. The new version of ISO 19115-2, which is under revision at the publication time of this Technical Specification, will refer to ISO 19115-1:2014.

© ISO 2016 – All rights reserved

Documents
Document Sharing Hub

Full document details: PD ISO/TS 19163-1:2016

4 Terms and definitions

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

4.1
attribute
named property of an entity

Note 1 to entry: Describes a geometrical, topological, thematic, or other characteristic of an entity.

[SOURCE: ISO/IEC 2382:2015, 2121440, modified — Note 1 to entry has been added.]

4.2
binding
specification of a mapping relating the information defined in a *content model* (4.3) (data and metadata) to the data format that carries that information

4.3
content model
information view of an application schema

Note 1 to entry: In this Technical Specification, a content model describes the required content components and their interrelationship of *imagery* (4.12) and gridded *thematic data* (4.14).

[SOURCE: ISO/TS 19129:2009, 4.1.2, modified — Note 1 to entry has been added.]

4.4
conversion rule
rule for converting instances in the input data structure to instances in the output data structure

[SOURCE: ISO 19118:2011, 4.7]

4.5
encoding rule
identifiable collection of *conversion rules* (4.4) that define the encoding for a particular data structure

EXAMPLE XML, ISO 10303-21, ISO/IEC 8211.

Note 1 to entry: An encoding rule specifies the types of data to be converted as well as the syntax, structure and codes used in the resulting data structure.

[SOURCE: ISO 19118:2011, 4.14]

4.6
fused image
image produced by fusing images from multiple sources

4.7
geopositioning
determining the geographic position of an object

[SOURCE: ISO/TS 19130:2010, 4.36, modified]

4.8
georectified
corrected for positional displacement with respect to the surface of the Earth

[SOURCE: ISO 19115-2:2009, 4.12]

© ISO 2016 – All rights reserved
Documents
Document Sharing Hub
Full document details: PD ISO/TS 19163-1:2016

4.9
georeferenceable
associated with a *geopositioning* (4.7) information that can be used to convert *grid* (4.10) coordinate values to values of coordinates referenced to an external coordinate reference system related to the Earth by a datum

4.10
grid
network composed of two or more sets of curves in which the members of each set intersect the members of the other sets in an algorithmic way

[SOURCE: ISO 19123:2005, 4.1.23, modified]

4.11
gridded data
data whose *attribute* (4.1) values are associated with positions on a *grid* (4.10) coordinate system

Note 1 to entry: Gridded data are a subtype of coverage data, which represent attribute values of geographic features in terms of a spatial grid.

[SOURCE: ISO 19115-2:2009, 4.17, modified — Note 1 to entry has been added.]

4.12
imagery
representation of phenomena as images produced by electronic and/or optical techniques

Note 1 to entry: The term imagery is often used colloquially with various meanings in different contexts. It is often used to describe any set of gridded, point set or other form of coverage data that can be portrayed.

[SOURCE: ISO/TS 19101-2:2008, 4.14, modified — Note 1 to entry has been added.]

4.13
looks
groups of signal samples in a SAR processor that splits the full synthetic aperture into several sub-apertures, each representing an independent look of the identical scene

Note 1 to entry: The resulting image formed by incoherent summing of these looks is characterized by reduced speckle and degraded spatial resolution.

4.14
thematic data
gridded data (4.11) whose *attribute* (4.1) values describe characteristics of a *grid* (4.10) coverage feature in a grid format

Note 1 to entry: Most gridded thematic data are derived from *imagery* (4.12) data using geophysical/atmospheric inversion algorithms. Gridded thematic data may also be obtained from other sources such as digitization of topographic map sheets.

4.15
ungeoreferenced grid
gridded data (4.11) that does not include any information that can be used to determine a cell's geographic coordinate values

EXAMPLE A digital photo without georectification information included.

© ISO 2016 – All rights reserved

Documents
Document Sharing Hub
Full document details: PD ISO/TS 19163-1:2016

5 Symbols and abbreviated terms

5.1 Abbreviated terms

BIIF	Basic Image Interchange Format
CRS	Coordinate Reference System
DEM	Digital Elevation Model
EOS	Earth Observing System
HDF	Hierarchical Data Format
JPEG200	Joint Photographic Experts Group 2000
netCDF	network Common Data Form
SAR	Synthetic aperture radar
TIFF	Tagged Image File Format
UML	Unified Modeling Language

5.2 UML notations

This Technical Specification presents conceptual models of imagery and gridded data, specified in the Unified Modeling Language (UML). ISO 19103 describes the way in which UML is used in the ISO 19100[2)] family of standards. It differs from standard UML only in the existence and interpretation of some special stereotypes, in particular, "CodeList". ISO 19103 specifies the basic data types used in the UML model. The UML diagrams defined in this Technical Specification represent conceptual models only and are not intended for automatic encoding within XML Schema.

Annex B contains a data dictionary for the UML models defined in this Technical Specification.

Table 1 lists the prefixes of UML classes used in the referenced ISO standards in this Technical Specification. IE is the prefix of the UML classes defined in this Technical Specification. In Table 1, the first column describes the prefix used in the packages of the second column and the third column is the ISO standard where the package is defined.

2) This International Standard is under preparation.

© ISO 2016 – All rights reserved
Documents
Document Sharing Hub
Full document details: PD ISO/TS 19163-1:2016

Table 1 — UML package identifiers

Identifier	Package	International Standard
EX	Extent information	ISO 19115-1
LE	Lineage extended	ISO 19115-2
LI	Lineage	ISO 19115-1
MD	Metadata	ISO 19115-1
MI	Metadata for imagery	ISO 19115-2
SD	Sensor data	ISO/TS 19130
CV	Coverage	ISO 19123
CA	Calibration and validation of sensor	ISO/TS 19159-1
GM	Geometry root	ISO 19107
IE	Content components and encoding rules for imagery and gridded data	ISO 19163

6 Related International Standards

Figure 1 illustrates the relationship between this Technical Specification and other International Standards related to imagery and gridded data. This Technical Specification fits the reference model defined in ISO/TS 19101-2 and follows the abstract content framework defined in ISO 19123. CV_Coverage is chosen as the super-class to establish the content component model of imagery and gridded data.

This Technical Specification refers to metadata related to imagery and gridded data defined in ISO 19115-1 and ISO 19115-2, the sensor information related to acquisition of imagery defined in ISO/TS 19130 and the calibration and validation of sensors defined in ISO/TS 19159-1.

This Technical Specification defines an UML schema for the content model which can be bound with any widely used data formats of imagery and gridded data, such as GeoTIFF, BIIF, JPEG 2000, NetCDF and HDF.

© ISO 2016 – All rights reserved

Documents
Document Sharing Hub
Full document details: PD ISO/TS 19163-1:2016

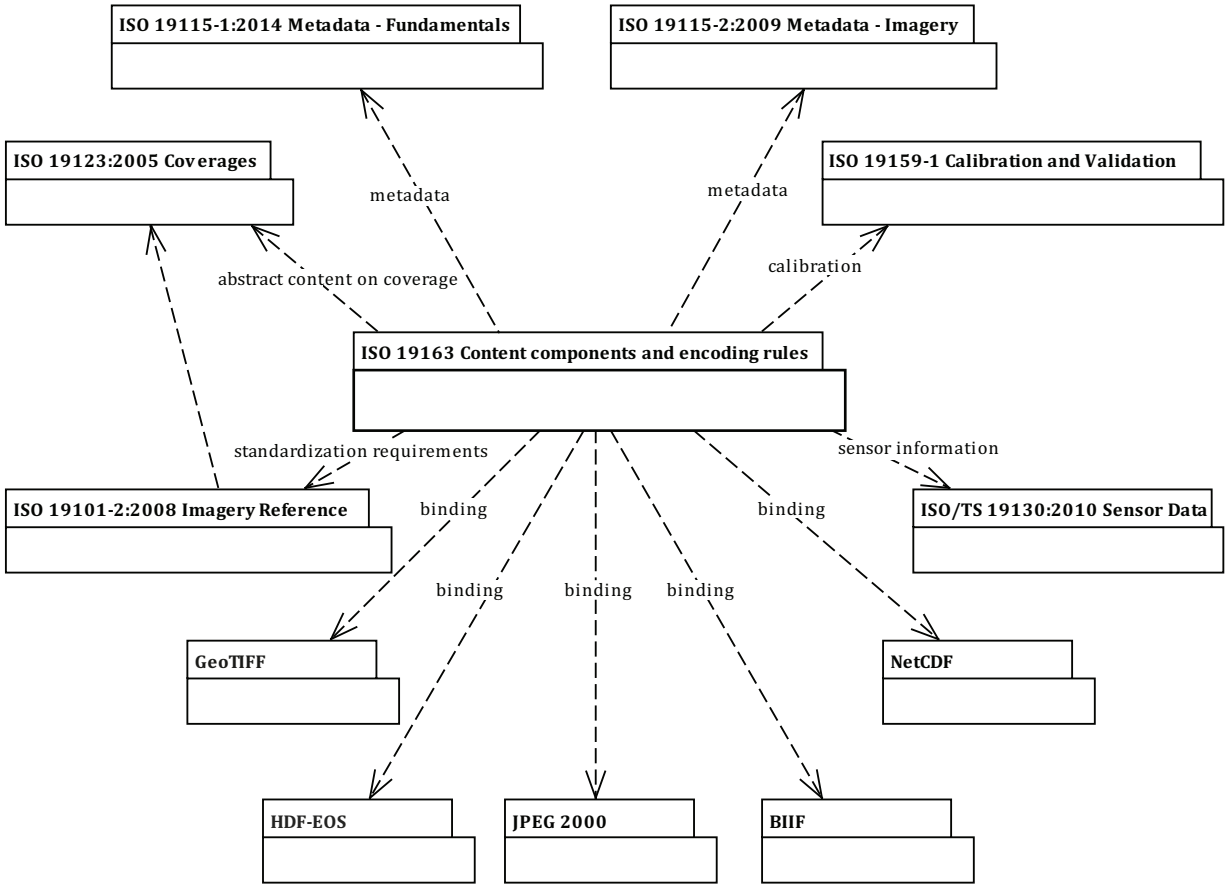

Figure 1 — Relationship with related International Standards

7 Categories of imagery and gridded data

7.1 General

Clause 7 categorizes imagery according to digital sensor types and gridded data according to the attribute and geometry properties. The required content components of each data category are specified in UML content models of Clause 8.

The intention of this Technical Specification is not to define a comprehensive classification system of imagery and gridded data, but to specify the contents of some categories of them. A hierarchical category framework of imagery and gridded data is defined in Figure 2. The root of the framework is Coverage defined in ISO 19123. Imagery and gridded data are a subclass of coverage. The two subclasses of imagery and gridded data, which are imagery data and thematic gridded data, are defined in this Technical Specification.

© ISO 2016 – All rights reserved
Documents
Document Sharing Hub
Full document details: PD ISO/TS 19163-1:2016

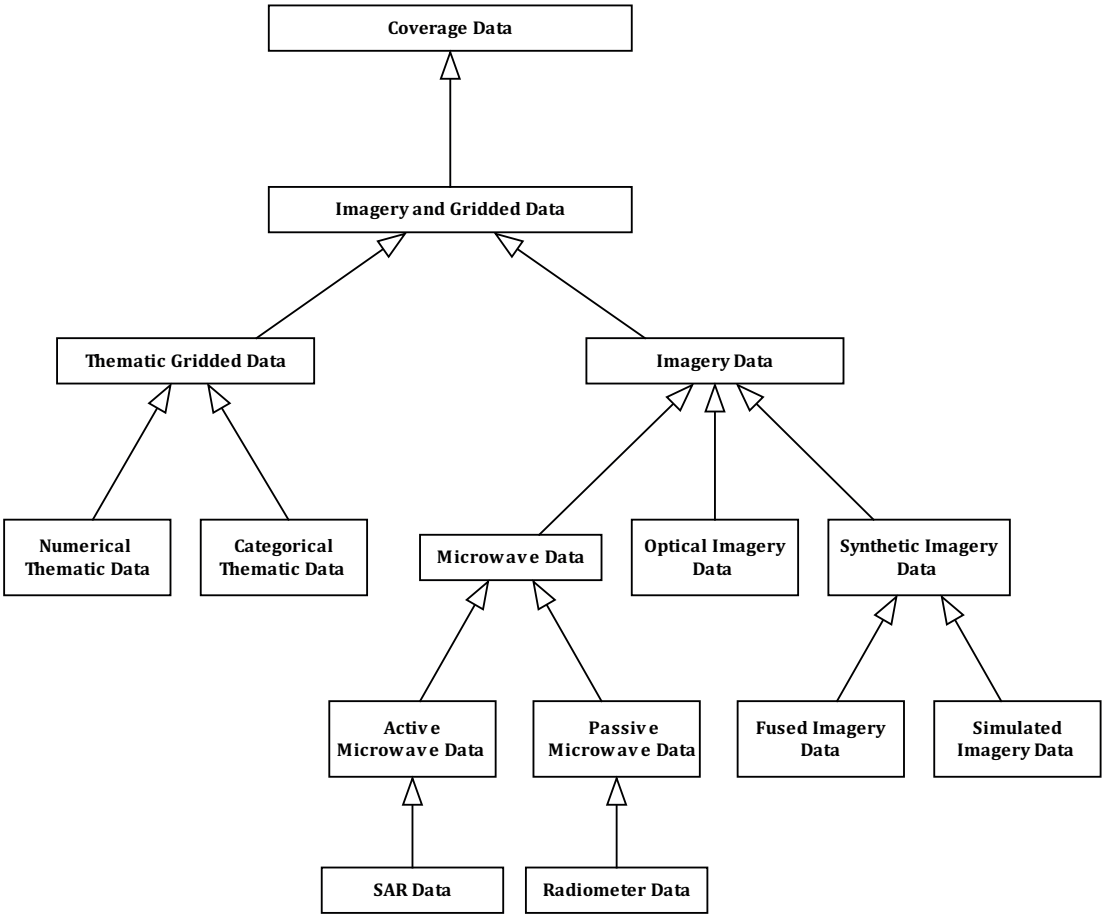

Figure 2 — Categories of imagery and gridded data

7.2 Imagery

Imagery is a kind of coverage whose attribute values are numerical representations of the physical parameters (e.g. radiance) measured by imagery sensors. According to ISO/TS 19101-2, a sensor can be classified as an electromagnetic energy sensor or a mechanical wave energy sensor based on the type of energy sensed by the sensor. The former class is further categorized into an optical sensor, a microwave sensor or a light detection and ranging sensor (LiDAR) according to the measurand of the sensor (ISO/TS 19130). SONAR is a typical example of mechanical wave energy sensor. These sensors produce optical, microwave, LiDAR and SONAR imagery data, respectively.

The data acquired by LiDAR and SONAR, which exhibit distinct characteristics that differ from optical images and microwave data, are not covered by this Technical Specification due to the limit of the scope. These types of data may be addressed in a future extension or subsequent part of ISO 19163.

Optical images are acquired from visible and infrared sensors by detecting the radiation reflected or emitted from target objects (ISO/TS 19101-2). Different materials reflect, absorb or emit radiation at different wavelengths, and accordingly each object type has a spectral signature. Analysing spectral signatures within remotely sensed images identifies differentiation between these objects. Thus, images may be classified depending on the number of spectral bands, for example panchromatic, multispectral and hyperspectral.

Microwave data are classified into active and passive microwave data corresponding to active and passive microwave sensors. Synthetic aperture radar (SAR) is a typical active microwave sensor that uses a series of radar pulses transmitted and received over time from a moving platform to create an image, as specified by ISO/TS 19130.

© ISO 2016 – All rights reserved

Documents
Document Sharing Hub
Full document details: PD ISO/TS 19163-1:2016

Passive microwave sensors measure the energy and/or the phase of microwaves emitted from objects. Passive microwave data can be used to derive various geophysical quantities, such as rainfall, sea surface temperature, vertical water vapour, ocean surface wind speed, sea ice parameters, snow water equivalent and soil surface moisture (ISO/TS 19101-2). There is more than one type of passive microwave data, but this Technical Specification only specifies the contents of microwave imaging radiometer data.

In addition to images acquired directly by a certain sensor, image fusion and image simulation techniques can generate new images from original images, fused image and simulated image. The image fusion techniques allow the integration of images from different sources. The fused image can have complementary multisource characteristics. For example, a higher-spatial-resolution panchromatic image is fused with lower-spatial-resolution multispectral data to provide multispectral information with higher spatial resolution; optical images and SAR data can be merged in order to simultaneously exploit the spectral and textural information.

7.3 Gridded data

Gridded data are a subtype of coverage (ISO 19115-2). In order to avoid the content overlap, this Technical Specification limits gridded data to regularly spaced gridded thematic data whose attribute values are values of a geographic feature (e.g. altitude, leaf area index) and whose geometric state is regularly spaced quadrilateral grid.

Most thematic data are derived from imagery by information retrieval processing with domain-specific or application-specific algorithms. Some thematic data, such as Digital Elevation Model (DEM) and scanned or rasterized data, are not necessarily derived from imagery data. DEM and rasterized data are often integrated with imagery data in various applications, for example a 3D virtual terrain. There are several different geometric states for thematic data, gridded-based, point-based, surface-based and segmented based one (ISO/TS 19101-2). This Technical Specification only defines the content of regular-gridded thematic data.

Thematic data have categorical attributes or numerical attributes of a geographic feature or phenomenon. Typical examples of numerical data are DEM and land surface temperature, and those of categorical data are land cover and land use data. Categorical attributes shall not be interpolated.

8 Content component models

8.1 General

This Technical Specification defines the required content components of imagery and gridded data based on the hierarchical category framework (Figure 2). 8.2 to 8.4 describe these categories using UML model diagrams and the corresponding data dictionary is given in Annex B.

8.2 Imagery and gridded data

8.2.1 General

The structure and association of imagery and gridded data are illustrated in Figure 3. The topmost class of this Technical Specification, IE_ImageryAndGriddedData, is a subclass of CV_Coverage defined in ISO 19123. The information of coordinate reference system is specified in ISO 19111. IE_Georectified and IE_Georeferenceable are aggregated to describe the associate geolocation information of georectified and georeferenceable data, respectively.

The data dictionary of this UML diagram is given in B.1.

© ISO 2016 – All rights reserved
Documents
Document Sharing Hub
Full document details: PD ISO/TS 19163-1:2016