TECHNICAL SPECIFICATION

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Geographic information — Imagery, gridded and coverage data framework

Information Géographique — Structure de données pour les images, les matrices et les mosaïques

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Foreword

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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.

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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/TS 19129 was prepared by Technical Committee ISO/TC 211, *Geographic information/Geomatics*.

Introduction

Gridded data, including imagery, is a major form of geographic information. Over the past two decades many, largely incompatible, standards have been developed that are widely used for the interchange of geographic imagery and gridded data. These include standards developed by ISO, as well as those developed by other organizations. With so many different imagery and gridded data standards, each standard aimed at different but overlapping information communities, there is a considerable legacy problem. Working with data encoded using different formats is often difficult because all of the necessary information for interworking has not been recorded using some of these standards. It is not possible to develop a new comprehensive standard to replace what exists or to simply endorse one existing standard (or industrial specification) to "solve" the interworking problem, because very large volumes of data exist in the various formats already in use. The Technical Report ISO/TR 19121:2000 identified the existing work on imagery and gridded data that had been ongoing in ISO and external technical organizations. What is required is a structure that allows for the specification of the content in a manner independent of and compatible with the various different encoding standards.

The area of imagery, gridded and coverage data is one of the most challenging within the field of geographic information. The data appears to be simple; however, there is significant structural complexity. While most data is organized in simple grids, there are many different traversal methods for grids and structures that support the distribution of attributes over a space. Sensor information and associated georeferencing are an important aspect of imagery, gridded and coverage geographic information.

This Technical Specification endeavours to address the harmonization of the broad legacy of existing imagery and gridded data. The approach specified is *not* to build a very flexible standard that encompasses everything with a broad array of options, since that does not create compatibility. One can be fooled into thinking things are standardized, because two data sets use incompatible subsets of the same set of general standards. All that would be accomplished would be to give an ISO label to the existing diversity and incompatibility. Compatibility is required for the underlying structure and primary elements of information content, regardless of how that information content is expressed. The purpose of this Technical Specification is to provide a framework within which interworking can occur. The approach used is to define a set of a few common information content structures for geographic imagery, gridded data and certain types of coverage data, which can be expressed using different encoding mechanisms and different interchange standards. The compatibility results from the common underlying content models that are expressed as a *generic set of UML patterns for application schemas*.

This Technical Specification recognizes that there are many overlapping imagery and gridded data specifications in wide use that differ significantly in how the information content is structured for encoding and in what choices of information form the content model. Different types of encoding may be appropriate in different situations. However, differences in content are difficult to reconcile. The existing different encoding standards do not necessarily conflict because they represent different ways of providing the same information in different contexts. Differences in content are also permitted for different situations, but the content definition must be the same in similar situations for interchange to be achieved without loss of information.

Most of the existing specifications for imagery and gridded data used in industry specify how content is to be expressed, rather than the content itself. They relate content to encoding, encapsulation and transfer of data. Those content descriptions that do appear to vary from one specification to another may not be in conflict or incompatible but reflect different real world situations that require different treatments.

This Technical Specification combines a number of well-defined content structures in accordance with ISO 19123, the International Standard for coverage geometry and functions together with metadata, spatial referencing and other aspects of imagery, gridded and coverage data into a framework. This will foster a convergence at the content model level for existing imagery, gridded and coverage data while allowing for backward compatibility with the identified suite of existing standards.

Geographic information — Imagery, gridded and coverage data framework

1 Scope

This Technical Specification defines the framework for imagery, gridded and coverage data. This framework defines a content model for the content type imagery and for other specific content types that can be represented as coverage data. These content models are represented as a set of generic UML patterns for application schemas.

2 Conformance

Any application schema or profile claiming conformance with this Technical Specification shall pass the requirements described in the abstract test suite, presented in Annex A.

The abstract test suite indicates what is required for an application schema to comply with the framework established in this Technical Specification.

3 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 19107, *Geographic information — Spatial schema*

ISO 19109:2005, *Geographic information — Rules for application schema*

ISO 19115, *Geographic information — Metadata*

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

ISO 19118, *Geographic information — Encoding*

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

4 Terms and definitions

4.1 Terms

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

4.1.1
application schema
conceptual schema for data required by one or more applications

[ISO 19101:2002]

4.1.2
content model
information view of an **application schema**

NOTE The term “information view” comes from the ISO Reference Model for Open Distributed Processing (RM-ODP), as specified in 19101-2.

4.1.3
continuous coverage
coverage that returns different values for the same **feature** attribute at different **direct positions** within a single spatial object, temporal object, or **spatiotemporal object** in its **domain**

[ISO 19123:2005]

NOTE Although the **spatiotemporal domain** of a continuous coverage is ordinarily bounded in terms of its spatial extent, it can be subdivided into an infinite number of **direct positions**.

4.1.4
coordinate
one of a sequence of n-numbers designating the position of a **point** in n-dimensional space

[ISO 19111:2007]

NOTE In a **coordinate reference system**, the numbers must be qualified by units.

4.1.5
coordinate reference system
coordinate system that is related to an object by a datum

[ISO 19111:2007]

NOTE For geodetic and vertical datums it will be related to the Earth.

4.1.6
coverage
feature that acts as a **function** to return values from its **range** for any **direct position** within its spatial, temporal or **spatiotemporal domain**

[ISO 19123:2005]

EXAMPLE Examples include a **raster** image, polygon overlay, or digital elevation **matrix**.

4.1.7
data compaction
reduction of the number of data elements, bandwidth, cost, and time for the generation, transmission, and storage of data without loss of information by eliminating unnecessary redundancy, removing irrelevancy, or using special coding

[ANSI T1.523-2001]

NOTE 1 Whereas data compaction reduces the amount of data used to represent a given amount of information, **data compression** does not.

NOTE 2 Data compaction can be done through aggregation of like values in adjacent **grid** cells, tiling schemes or other means of eliminating information that is not relevant.

4.1.8
data compression
reducing either the amount of storage space required to store a given amount of data, or the length of message required to transfer a given amount of information

NOTE 1 Adapted from ANSI T1.523-2001.

NOTE 2 Data compression is probabilistic in nature based on particular instances of **imagery**, **gridded** or **coverage data** and is related to **encoding** and is outside the scope of this Technical Specification.

4.1.9
data interchange
delivery, receipt and interpretation of data

[ISO 19118:2005]

4.1.10
dataset
identifiable collection of data

[ISO 19115:2003]

4.1.11
direct position
position described by a single set of **coordinates** within a **coordinate reference system**

[ISO 19107:2003]

4.1.12
discrete coverage
coverage that returns the same **feature** attribute values for every **direct position** within any single spatial object, temporal object, or **spatiotemporal object** in its **domain**

[ISO 19123:2005]

NOTE The **spatiotemporal domain** of a discrete coverage consists of a finite set of geometric objects.

4.1.13
domain
well-defined set

[ISO/TS 19103:32005]

NOTE Domains are used to define the domain set and **range** set of attributes, operators and **functions**.

4.1.14
encoding
conversion of data into a series of codes

[ISO 19118:2005]

4.1.15
encoding rule
identifiable collection of conversion rules that define the **encoding** for a particular data structure

[ISO 19118:2005]

4.1.16
feature
abstraction of real world phenomena

[ISO 19101:2002]

NOTE A feature may occur as a type or an instance. Feature type or feature instance should be used when only one is meant.

4.1.17
framework
relationship between the elements of the **content model** and the separate **encoding** and portrayal mechanisms

4.1.18
function
rule that associates each element from a **domain** (source, or domain of the function) to a unique element in another domain (target, co-domain, or **range**)

[ISO 19107:2003]

4.1.19
geographic information
information concerning phenomena implicitly or explicitly associated with a location relative to the Earth

[ISO 19101:2002]

4.1.20
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

[ISO 19123:2005]

NOTE The curves partition a space into grid cells.

4.1.21
grid coordinates
sequence of two or more numbers specifying a position with respect to its location on a **grid**

[ISO 19115-2:2009]

4.1.22
grid point
point located at the intersection of two or more curves in a **grid**

[ISO 19123:2005]

4.1.23
gridded data
data whose attribute values are associated with positions on a **grid coordinate** system

[ISO 19115-2:2009]

4.1.24
imagery
representation of phenomena as images produced by electronic and/or optical techniques

NOTE 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. This is not a very useful concept because virtually any set of data can be portrayed in some manner. A more precise meaning is given in ISO/TS 19101-2.

[ISO/TS 19101-2:2008]

4.1.25
matrix
rectangular array of numbers

NOTE A matrix is a mathematical term.

4.1.26
metadata
data about data

[ISO 19115:2003]

4.1.27
pixel
smallest element of a digital image to which attributes are assigned

NOTE 1 This term originated as a contraction of "picture element".

NOTE 2 Related to the concept of a **grid** cell.

[ISO/TS 19101-2:2008]

4.1.28
point
0-dimensional geometric primitive, representing a position

[ISO 19107:2003]

NOTE The boundary of a point is the empty set.

4.1.29
point coverage
coverage that has a **domain** composed of **points**

[ISO 19123:2005]

4.1.30
quality
totality of characteristics of a product that bear on its ability to satisfy stated and implied needs

[ISO 19101:2002]

4.1.31
range
⟨coverage⟩ set of **feature** attribute values associated by a **function** with the elements of the **domain** of a **coverage**

[ISO 19123:2005]

4.1.32
raster
usually rectangular pattern of parallel scanning lines forming or corresponding to the display on a cathode ray tube

[ISO 19123:2005]

NOTE 1 A raster is a type of **grid**.

NOTE 2 The term “raster data” is often used colloquially in the field of **geographic information** to identify the whole class of data where the spatial geometry is organized into a grid. A description of what is meant by “raster data” is given in ISO 19123 and the more comprehensive concept of a **coverage** is described.

4.1.33
service
distinct part of the functionality that is provided by an entity through interfaces

[ISO/TR 14252:1996]

4.1.34
spatiotemporal domain
〈coverage〉
domain composed of **spatiotemporal objects**

[ISO 19123:2005]

NOTE The spatiotemporal domain of a **continuous coverage** consists of a set of **direct positions** defined in relation to a collection of spatiotemporal objects.

4.1.35
spatiotemporal object
object representing a set of **direct positions** in space and time

[ISO 19123:2005]

4.1.36
surface
2-dimensional geometric primitive, locally representing a continuous image of a region of a plane

[ISO 19107:2003]

4.1.37
tessellation
partitioning of a space into a set of conterminous subspaces having the same dimension as the space being partitioned

[ISO 19123:2005]

NOTE A tessellation composed of congruent regular polygons or polyhedra is a regular tessellation; one composed of regular, but non-congruent polygons or polyhedra is semi-regular. Otherwise, the tessellation is irregular.

4.1.38
traversal order
sequence in which the cells of a **grid** are enumerated

4.1.39
UML template
parameterized model element that describes or identifies the pattern for a group of model elements of a particular type

[IBM Rational System Developer]

4.2 Abbreviated terms

BIIF	Basic Image Interchange Format
DEM	Digital Elevation Model
GCP	Ground Control Point
GeoTIFF	Geographic TIFF
GIS	Geographic Information System
GML	Geography Markup Language
HDF-EOS	Hierarchical Data Format - Earth Observing System
JPEG	Joint Photographic Experts Group
LUT	Look-Up Table
RGB	Red Green Blue
TIFF	Tagged Image File Format
TIN	Triangulated Irregular Network
UML	Unified Modeling Language
XML	eXtensible Markup Language

4.3 Notation

The conceptual schema specified in this Technical Specification is described using the Unified Modeling Language (UML), following the guidance of ISO/TS 19103.

Several model elements used in this schema are defined in other ISO geographic information standards. By convention within ISO/TC 211, names of UML classes, with the exception of basic data type classes, include a two letter prefix that identifies the standard and the UML package in which the class is defined. UML classes defined in this Technical Specification have the two letter prefix of IF. Table 1 lists the other International Standards and packages in which UML classes used in this Technical Specification have been defined.

Table 1 — Sources of externally defined UML classes

Prefix	Standard	Package
CV	19123	Coverage Core & Discrete Coverages
EX	19115	Metadata extent information
GF	19109	General Feature Model
GM	19107	Geometry Root
MD	19115	Metadata entity set information
MI	19115-2	Metadata entity set imagery