
**Geographic information — Reference
model —**

**Part 2:
Imagery**

Information géographique — Modèle de référence —

Partie 2: Imagerie
iTeh STANDARD PREVIEW
(standards.iteh.ai)

ISO/TS 19101-2:2008

<https://standards.iteh.ai/catalog/standards/sist/5e1e518f-8bd5-449e-bd1f-8fa023563d02/iso-ts-19101-2-2008>



PDF disclaimer

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.

iTeh STANDARD PREVIEW
(standards.iteh.ai)

ISO/TS 19101-2:2008

<https://standards.iteh.ai/catalog/standards/sist/5e1e518f-8bd5-449e-bd1f-8fa023563d02/iso-ts-19101-2-2008>



COPYRIGHT PROTECTED DOCUMENT

© ISO 2008

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

Foreword.....	v
Introduction	vi
1 Scope	1
2 Conformance	1
2.1 General.....	1
2.2 Enterprise conformance	1
2.3 Sensor conformance	1
2.4 Imagery data conformance	1
2.5 Imagery services conformance	1
2.6 Image processing system conformance	1
3 Normative references	2
4 Terms and definitions.....	2
5 Abbreviated terms and symbols	7
5.1 Abbreviated terms	7
5.2 Symbols	9
6 Notation	10
7 Enterprise Viewpoint – community objectives and policies	10
7.1 General.....	10
7.2 Geographic imagery community objective	10
7.3 Geographic imagery scenario	10
7.4 Geographic imagery policies	11
7.4.1 Introduction to policies	11
7.4.2 Policy development guidelines	12
7.4.3 Policies	12
8 Information Viewpoint – knowledge based decisions	13
8.1 Introduction to Information Viewpoint.....	13
8.1.1 Introduction to types of geographic imagery	13
8.1.2 Creating knowledge from imagery	14
8.1.3 General Feature Model	16
8.1.4 Topics relevant across data, information, and knowledge	17
8.2 Sensor data package	18
8.2.1 General.....	18
8.2.2 Sensors and platforms	18
8.2.3 Optical sensing	19
8.2.4 Microwave sensing	21
8.2.5 LIDAR sensor	24
8.2.6 Sonar sensor	27
8.2.7 Digital images from film	28
8.2.8 Scanned maps.....	28
8.2.9 Calibration, validation and metrology	28
8.2.10 Position and attitude determination	29
8.2.11 Image acquisition request	30
8.3 Geographic imagery information – processed, located, gridded	30
8.3.1 General.....	30
8.3.2 IG_Scene.....	30
8.3.3 Derived imagery	34
8.3.4 Imagery metadata	37
8.3.5 Encoding rules for imagery	38

8.3.6	Imagery compression	39
8.4	Geographic imagery knowledge – inference and interpretation	40
8.4.1	General	40
8.4.2	Knowledge from imagery	40
8.4.3	Image understanding and classification	40
8.4.4	IG_KnowledgeBase	42
8.5	Geographic imagery decision support – context-specific applications	44
8.5.1	General	44
8.5.2	Decision support services	44
8.5.3	Geographic portrayal	45
8.5.4	Fitness for Use Context	48
8.5.5	Decision fusion	50
9	Computational Viewpoint – services for imagery	50
9.1	Task-oriented computation	50
9.2	Computational patterns	50
9.3	Geographic imagery services	52
9.4	Service chaining for imagery	53
9.5	Service metadata	53
10	Engineering Viewpoint – deployment approaches	54
10.1	General	54
10.2	Distributed system for geographic imagery	54
10.3	Imagery Collection Node	55
10.4	Sensor Processing Node	56
10.5	Imagery Archive Node	57
10.6	Value Added Processing Node	58
10.7	Decision Support Node	59
10.8	Channels: networks and DCPs	60
10.8.1	Imagery considerations for channels	60
10.8.2	Space to ground communications	60
Annex A (normative)	Abstract test suite	61
Annex B (informative)	ISO Reference Model for Open Distributed Processing (RM-ODP)	63
Annex C (informative)	Imagery use cases	64
Annex D (informative)	Principles relating to remote sensing of the Earth from space	68
Bibliography	71

IT IS STANDARD PREVIEW

(standards.itech.ai)

ISO/TS 19101-2:2008

<https://standards.itech.ai/catalog/standards/siv/5c1e518f-8bd5-449c-bd1f-360935040374/iso-ts-19101-2-2008>

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.

In other circumstances, particularly when there is an urgent market requirement for such documents, a technical committee may decide to publish other types of document:

- an ISO Publicly Available Specification (ISO/PAS) represents an agreement between technical experts in an ISO working group and is accepted for publication if it is approved by more than 50 % of the members of the parent committee casting a vote;
- an ISO Technical Specification (ISO/TS) represents an agreement between the members of a technical committee and is accepted for publication if it is approved by 2/3 of the members of the committee casting a vote.

ISO/TS 19101-2:2008

An ISO/PAS or ISO/TS is reviewed after three years in order to decide whether it will be confirmed for a further three years, revised to become an International Standard, or withdrawn. If the ISO/PAS or ISO/TS is confirmed, it is reviewed again after a further three years, at which time it must either be transformed into an International Standard or be withdrawn.

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 19101-2 was prepared by Technical Committee ISO/TC 211, *Geographic information/Geomatics*.

ISO 19101 consists of the following parts, under the general title *Geographic information — Reference model*:

- *Part 1: Fundamental*¹⁾
- *Part 2: Imagery* [Technical Specification]

1) To be published. (Revision of ISO 19101:2002)

Introduction

This Technical Specification provides a reference model for processing of geographic imagery which is frequently done in open distributed manners. The motivating themes addressed in this reference model are given below.

In terms of volume, imagery is the dominant form of geographic information.

- Stored geographic imagery volume will grow to the order of an exabyte.
- National imagery archives are multiple petabytes in size; ingesting a terabyte per day.
- Individual application data centers are archiving hundreds of terabytes of imagery.
- Tens of thousands of datasets have been catalogued but are not yet online.

Large volumes of geographic imagery will not be portrayed directly by humans. Human attention is the scarce resource, and is insufficient to view petabytes of data. Semantic processing will be required: for example, automatic detection of features; data mining based on geographic concepts.

Information technology allows the sharing of geographic information products through processing of geographic imagery. Standards are needed to increase creation of products. A number of existing standards are used for the exchange of geographic imagery.

Examples of technical, legal, and administrative hurdles to moving imagery online include

- technical issues of accessibility – geocoding, geographic access standards,
- maintenance of intellectual property rights,
- maintenance of individual privacy rights as resolution increases, and
- technical issues of compatibility requiring standards.

Governments have been the predominant suppliers of remotely sensed data in the past. This is changing with the commercialization of remotely sensed data acquisition. Geographic imagery is a key input to decision support for policy makers.

The ultimate challenge is to enable the geographic imagery collected from different sources to become an integrated digital representation of the Earth widely accessible for humanity's critical decisions.

Currently a large number of standards exist that describe imagery data. The processing of imagery across multiple organizations and information technologies (IT) is hampered by the lack of a common abstract architecture. The establishment of a common framework will foster convergence at the framework level. In the future, multiple implementation standards are needed for data format and service interoperability to carry out the architecture defined in this Technical Specification.

The objective of this Technical Specification is the coordinated development of standards that allow the benefits of distributed geographic image processing to be realized in an environment of heterogeneous IT resources and multiple organizational domains. An underlying assumption is that uncoordinated standardization activities made without a plan cannot be united under the necessary framework.

This Technical Specification provides a reference model for the processing of geographic imagery which is frequently done in open distributed manners. The basis for defining an information system in this

Technical Specification is the Reference Model for Open Distributed Processing (RM-ODP) [78]. A brief description of RM-ODP can be referenced in Annex B. The basis for defining geographic information in this specification is the ISO 19100 family of standards.

The RM-ODP [78] viewpoints are used in the following fashion:

- Typical users and their business activities, and policies to carry out those activities, are addressed in the Enterprise Viewpoint.
- Data structures and the progressive addition of value to the resulting products are found in the schemas of the Information Viewpoint.
- Individual processing services and the chaining of services are addressed in the Computational Viewpoint.

Approaches to deploy the components of the Information and Computational viewpoints to distributed physical locations are addressed in the Engineering Viewpoint.

iTeh STANDARD PREVIEW (standards.iteh.ai)

[ISO/TS 19101-2:2008](https://standards.iteh.ai/catalog/standards/sist/5e1e518f-8bd5-449e-bd1f-8fa023563d02/iso-ts-19101-2-2008)

<https://standards.iteh.ai/catalog/standards/sist/5e1e518f-8bd5-449e-bd1f-8fa023563d02/iso-ts-19101-2-2008>

iTeh STANDARD PREVIEW
(standards.iteh.ai)

ISO/TS 19101-2:2008

<https://standards.iteh.ai/catalog/standards/sist/5e1e518f-8bd5-449e-bd1f-8fa023563d02/iso-ts-19101-2-2008>

Geographic information — Reference model —

Part 2: Imagery

1 Scope

This part of ISO 19101 defines a reference model for standardization in the field of geographic imagery processing. This reference model identifies the scope of the standardization activity being undertaken and the context in which it takes place. The reference model includes gridded data with an emphasis on imagery. Although structured in the context of information technology and information technology standards, this Technical Specification is independent of any application development method or technology implementation approach.

2 Conformance

2.1 General

To conform to this Technical Specification, all of the conditions specified for at least one of the conformance classes described below shall be satisfied.

2.2 Enterprise conformance

Any enterprise that claims conformance to this Technical Specification shall satisfy all of the conditions specified in the Test module in A.1.

2.3 Sensor conformance

Any sensor for which conformance to this Technical Specification is claimed shall satisfy all of the conditions specified in the Test module in A.2.

2.4 Imagery data conformance

Any enterprise for which conformance to this Technical Specification is claimed shall satisfy all of the conditions specified in the Test module in A.3.

2.5 Imagery services conformance

Any enterprise for which conformance to this Technical Specification is claimed shall satisfy all of the conditions specified in the Test module in A.4.

2.6 Image processing system conformance

Any image processing system for which conformance to this Technical Specification is claimed shall satisfy all of the conditions specified in the Test module in A.5.

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 19115, *Geographic information — Metadata*

ISO 19119:2005, *Geographic information — Services*

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

4 Terms and definitions

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

4.1

band

range of wavelengths of electromagnetic radiation that produce a single response by a sensing device

4.2

calibration

process of quantitatively defining a system's responses to known, controlled signal inputs

[CEOS WGCV]

4.3

computational viewpoint

viewpoint on an ODP system and its environment that enables distribution through functional decomposition of the system into objects which interact at **interfaces**

[ISO/IEC 10746-3]

4.4

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]

4.5

digital elevation model

dataset of elevation values that are assigned algorithmically to 2-dimensional coordinates

4.6

digital number

DN

integer value representing a measurement as detected by a **sensor**

4.7

engineering viewpoint

viewpoint on an ODP system and its environment that focuses on the mechanisms and functions required to support distributed interaction between objects in the system

[ISO/IEC 10746-3]

iTeh STANDARD PREVIEW
(standards.iteh.ai)

ISO/TS 19101-2:2008
https://standards.iteh.ai/standards/sist/5e1e518f-8bd5-449e-bd1f-8fa023563d02/iso-ts-19101-2-2008

4.8**enterprise viewpoint**

viewpoint on an ODP system and its environment that focuses on the purpose, scope and policies for that system

[ISO/IEC 10746-3]

4.9**feature**

abstraction of real world phenomena

[ISO 19101]

4.10**geographic feature**

representation of real world phenomenon associated with a location relative to the Earth

4.11**geographic imagery**

imagery associated with a location relative to the Earth

4.12**geographic imagery scene**

geographic imagery whose data consists of measurements or simulated measurements of the natural world produced relative to a specified vantage point and at a specified time

[Derived from ISO 22028-1]

NOTE A geographic imagery scene is a representation of an environmental landscape; it may correspond to a remotely sensed view of the natural world or to a computer-generated virtual scene simulating such a view.

4.13**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]

4.14**imagery**

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

NOTE In this Technical Specification, it is assumed that the phenomena have been sensed or detected by one or more devices such as radar, cameras, photometers, and infrared and multispectral scanners.

4.15**information viewpoint**

viewpoint on an ODP system and its environment that focuses on the semantics of information and information processing

[ISO/IEC 10746-3]

4.16**interface**

named set of **operations** that characterizes the behaviour of an entity

[ISO 19119]

4.17
interoperability

capability to communicate, execute programs, or transfer data among various functional units in a manner that requires the user to have little or no knowledge of the unique characteristics of those units

[ISO 2382-1]

4.18
knowledge base

data base of knowledge about a particular subject

NOTE The data base contains facts, inferences, and procedures needed for problem solution [Webster Computer].

4.19
measurable quantity

attribute of a phenomenon, body or substance that may be distinguished qualitatively and determined quantitatively

[VIM]

4.20
measurement

set of operations having the object of determining the value of a quantity

[VIM]

4.21
measurand

particular quantity subject to measurement

[VIM]

iTeh STANDARD PREVIEW
(standards.iteh.ai)

<https://standards.iteh.ai/catalog/standards/sist/5e1e518f-8bd5-449e-bd1f-8fa023563d02/iso-ts-19101-2-2008>

EXAMPLE Vapour pressure of a given sample of water at 20 °C.

NOTE The specification of a measurand may require statements about quantities such as time, temperature and pressure.

4.22
metadata

data about data

[ISO 19115]

4.23
metric traceability

property of the result of a measurement or the value of a standard whereby it can be related to stated references, usually national or international standards, through an unbroken chain of comparisons all having stated uncertainties

[derived from VIM]

4.24
operation

specification of a transformation or query that an object may be called to execute

[ISO 19119]

NOTE An operation has a name and a list of parameters.

4.25**orthoimage**

image in which by orthogonal projection to a reference surface, displacement of image points due to sensor orientation and terrain relief has been removed

NOTE The amount of displacement depends on the resolution and the level of detail of the elevation information and on the software implementation.

4.26**picture original**

representation of a two-dimensional hardcopy or softcopy input image in terms of the colour-space coordinates (or an approximation thereof)

NOTE Picture originals could be obtained from printed maps, printed pictures of a geographic imagery scene, or drawings of geographic information, etc.

4.27**picture portrayal**

representations of image data in terms of the colour-space coordinates that are appropriate for, and tightly coupled to, the characteristics of a specified real or virtual output device and viewing

NOTE Picture portrayals are geared for visual display whether in hardcopy or softcopy.

4.28**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.

4.29**policy**

set of rules related to a particular purpose

[ISO/IEC 10746-2]

4.30**radiance**

at a point on a surface and in a given direction, the radiant intensity of an element of the surface, divided by the area of the orthogonal projection of this element on a plane perpendicular to the given direction

[ISO 31-6]

4.31**radiant energy**

energy emitted, transferred or received as radiation

[ISO 31-6]

4.32**record**

finite, named collection of related items (objects or values)

4.33**remote sensing**

collection and interpretation of information about an object without being in physical contact with the object

4.34
resolution (of a sensor)

smallest difference between indications of a sensor that can be meaningfully distinguished

NOTE For imagery, resolution refers to radiometric, spectral, spatial and temporal resolutions.

4.35
scene

spectral radiances of a view of the natural world as measured from a specified vantage point in space and at a specified time

[derived from ISO 22028-1]

NOTE A scene may correspond to a remotely sensed view of the natural world or to a computer-generated virtual scene simulating such a view.

4.36
sensor

element of a measuring instrument or measuring chain that is directly affected by the **measurand**

[VIM]

4.37
sensor model

description of the radiometric and geometric characteristics of a **sensor**

4.38
service

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

[ISO/IEC TR 14252]

ISO/TS 19101-2:2008
<https://standards.iteh.ai/catalog/standards/sist/5e1e518f-8bd5-449e-bd1f-8fa023563d02/iso-ts-19101-2-2008>

4.39
technology viewpoint

viewpoint on an ODP system and its environment that focuses on the choice of technology in that system

[ISO/IEC 10746-2]

4.40
uncertainty

parameter, associated with the result of measurement, that characterizes the dispersion of values that could reasonably be attributed to the **measurand**

[ISO 19116]

NOTE 1 The parameter may be, for example, a standard deviation (or a given multiple of it), or the half-width of an interval having a stated level of confidence.

NOTE 2 Uncertainty of measurement comprises, in general, many components. Some of these components may be evaluated from the statistical distribution of the results of series of measurements and can be characterized by experimental standard deviations. The other components, which can also be characterized by standard deviations, are evaluated from assumed probability distributions based on experience or other information.

NOTE 3 It is understood that the result of the measurement is the best estimate of the value of the measurand, and that all components of uncertainty, including those arising from systematic effects, such as components associated with corrections and reference standards, contribute to the dispersion.

4.41**validation**

process of assessing, by independent means, the quality of the data products derived from the system outputs

[CEOS WGCV]

4.42**viewpoint (on a system)**

form of abstraction achieved using a selected set of architectural concepts and structuring rules, in order to focus on particular concerns within a system

[ISO/IEC 10746-2]

5 Abbreviated terms and symbols**5.1 Abbreviated terms**

BIIF	Basic Image Interchange Format
CEOS	Committee on Earth Observation Satellites
CIE	International Commission on Illumination
CRS	Coordinate Reference System
CRT	Cathode Ray Tube
CMYK	Non-linear Cyan, Magenta, Yellow, Black
CW	Continuous Wavelength
DCP	Distributed Computing Platform
DEM	Digital Elevation Model
DIAL	Differential Absorption LIDAR
DN	Digital Number
DSS	Decision Support Service
EOS	Earth Observation Satellite
EOSDIS	Earth Observing System Data and Information System
FIFO	First In, First Out
FOV	Field of View
G	Gravity
GEO	Geosynchronous Earth Orbit
GEOTIFF	Tagged Image File Format for Geographic Imagery
GHz	Gigahertz