INTERNATIONAL STANDARD

ISO 19119

First edition
2005-02-15

Geographic information — Services

Information géographique — Services

Reference number
ISO 19119:2005(E)

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Published in Switzerland

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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

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

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

ISO 19119 was prepared by Technical Committee ISO/TC 211, *Geographic information/Geomatics*.

Introduction

The widespread application of computers and use of geographic information systems (GIS) have led to the increased analysis of geographic data within multiple disciplines. Based on advances in information technology, society's reliance on such data is growing. Geographic datasets are increasingly being shared, exchanged, and used for purposes other than their producers' intended ones. GIS, remote sensing, automated mapping and facilities management (AM/FM), traffic analysis, geopositioning systems, and other technologies for Geographic Information (GI) are entering a period of radical integration.

This International Standard provides a framework for developers to create software that enables users to access and process geographic data from a variety of sources across a generic computing interface within an open information technology environment.

— "a framework for developers" means that this International Standard is based on a comprehensive, common (i.e. formed by consensus for general use) plan for interoperable geoprocessing;

— "access and process" means that geodata users can query remote databases and control remote processing resources, and also take advantage of other distributed computing technologies, such as software delivered to the user's local environment from a remote environment for temporary use;

— "from a variety of sources" means that users will have access to data acquired in a variety of ways and stored in a wide variety of relational and non-relational databases;

— "across a generic computing interface" means that ISO 19119 interfaces provide reliable communication between otherwise disparate software resources that are equipped to use these interfaces;

— "within an open information technology environment" means that this International Standard enables geoprocessing to take place outside of the closed environment of monolithic GIS, remote sensing, and AM/FM systems that control and restrict database, user interface, network and data manipulation functions.

Geographic information — Services

1 Scope

The scope of this International Standard is as follows:

Identification and definition of the architecture patterns for service interfaces used for geographic information and definition of the relationships to the Open Systems Environment model.

This International Standard presents a geographic services taxonomy and a list of example geographic services placed in the services taxonomy.

This International Standard prescribes how to create a platform-neutral service specification, and how to derive platform-specific service specifications that are conformant with this.

This International Standard provides guidelines for the selection and specification of geographic services from both platform-neutral and platform-specific perspectives.

2 Conformance

Any product claiming conformance with this International Standard shall pass all the requirements described in the abstract test suite given in Annex A.

NOTE The definition of an abstract test suite appears in ISO 19105.

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/IEC 10746-1:1998, *Information technology — Open Distributed Processing — Reference model: Overview — Part 1*

ISO/IEC 10746-2:1996, *Information technology — Open Distributed Processing — Reference model: Foundations*

ISO/IEC TR 14252:1996, *Information technology — Guide to the POSIX Open System Environment (OSE)*

ISO/TS 19103: —[1], *Geographic information — Conceptual schema language*

ISO 19115:2003, *Geographic information — Metadata*

1) To be published.

4 Terms and definitions

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

4.1
service
distinct part of the functionality that is provided by an entity through **interfaces** (4.2)

[adapted from ISO/IEC TR 14252]

NOTE See 7.2 for a discussion of service.

4.2
interface
named set of **operations** (4.3) that characterize the behaviour of an entity

NOTE See 7.2 for a discussion of interface.

4.3
operation
specification of a transformation or query that an object may be called to execute

NOTE 1 An operation has a name and a list of parameters.

NOTE 2 See 7.2 for a discussion of operation.

4.4
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/IEC 2382-1]

4.5
service chain
sequence of **services** (4.1) where, for each adjacent pair of services, occurrence of the first action is necessary for the occurrence of the second action

4.6
workflow
automation of a business process, in whole or part, during which documents, information or tasks are passed from one participant to another for action, according to a set of procedural rules

4.7
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]

4.8
enterprise viewpoint
viewpoint (4.7) on an ODP system and its environment that focuses on the purpose, scope and policies for that system

4.9
information viewpoint
viewpoint (4.7) on an ODP system and its environment that focuses on the semantics of information and information processing

4.10
computational viewpoint
viewpoint (4.7) on a system and its environment that enables distribution through functional decomposition of the system into objects which interact at **interfaces** (4.2)

4.11
engineering viewpoint
viewpoint (4.7) on an ODP system and its environment that focuses on the mechanisms and functions required to support distributed interaction between objects in the system

4.12
technology viewpoint
viewpoint (4.7) on an ODP system and its environment that focuses on the choice of technology in that system

4.13
distribution transparency
property of hiding from a particular user the potential behaviour of some parts of a distributed system

[ISO/IEC 10746-2]

NOTE Distribution transparencies enable complexities associated with system distribution to be hidden from applications where they are irrelevant to their purpose.

5 Abbreviated terms

ADO	ActiveX Data Objects
API	Application Programming Interface
CCM	Client Configuration Manager
COM	Component Object Model
CORBA	Common Object Request Broker Architecture
CICS	Customer Information Control System
DAG	Directed Acyclic Graph
DCOM	Distributed Component Object Model
DCP	Distributed Computing Platform
DEM	Digital Elevation Model
DNA	Distributed interNet Applications
EDOC	Enterprise Distributed Object Computing
DTD	Document type definitions
EJB	Enterprise Java Beans
EOSE	Extended Open Systems Environment Model
ERP	Enterprise Resource Planning
GIOP	General Inter-ORB Protocol
GUI	Graphic User Interface
HIS	Information Technology Human Interaction Service
HTI	Human Technology Interface
HTML	Hypertext Markup language
HTTP	Hypertext Transfer Protocol
IDL	Interface Definition Language
IIOP	Internet Inter-ORB Protocol
IIS	Internet Information Server
IT	Information Technology

J2EE	Java 2 Enterprise Edition with EJB
JDBC	Java Data Base Connectivity
JSP	Java Server Pages
JINI	Sun's open architecture that enables developers to create network-centric services
JNDI	Java Naming and Directory Interface
JTA	Java Connector Architecture
JTS	Java Transaction Service
MAPI	Messaging Application Programming Interface
MS MTS	Microsoft Transaction Server
MSMQ	Microsoft Message Queuing
MTS	Microsoft Transaction Server
OCL	Object Constraint Language
ODBC	Open Database Connectivity
ODMG	Object Database Management Group
ODP	Open Distributed Processing (see RM-ODP)
OGC	Open GIS Consortium
OMG	Object Management Group
OODB	Object-oriented database
ORB	Object Request Broker
OSE	Open Systems Environment
RMI	Remote Method Invocation
RM-ODP	Reference Model of Open Distributed Processing (ISO/IEC 10746)
RPC	Remote Procedure Call
SDAI	Standard Data Access Interface (ISO 10303-22)
SOAP	Simple Object Access Protocol
SOF	Service Organizer Folder
SQL	Structured Query Language
UML	Unified Modelling Language
URI	Uniform Resource Identifier
XML	Extensible Markup Language
XML RDF	XML Resource Description Framework
XSLT	XML Stylesheet Language Transformations

6 Overview of geographic services architecture

6.1 Purpose and justification

The definition of service includes a variety of applications with different levels of functionality to access and use geographic information. While specialized services will appropriately remain an area for proprietary products, standardization of the interfaces to those services allows interoperability between proprietary products. Geographic information system and software developers will use these standards to provide general and specialized services that can be used for all geographic information. The approach of this International Standard is integrated with the approaches being developed within the more general world of information technology.

The geographic services architecture specified in this International Standard has been developed to meet the following purposes:

— provide an abstract framework to allow coordinated development of specific services;

— enable interoperable data services through interface standardization;

— support development of a service catalogue through the definition of service metadata;

— allow separation of data instances and service instances;

— enable use of one provider's service on another provider's data;

— define an abstract framework which can be implemented in multiple ways.

This International Standard extends the architectural reference model defined in ISO 19101, in which an Extended Open Systems Environment (EOSE) model for geographic services is defined.

6.2 Interoperability reference model based on ISO RM-ODP

This International Standard is developed based on a system architecture approach to system design known as the Reference Model of Open Distributed Processing; see ISO/IEC 10746. Architecture is defined as a set of components, connections and topologies defined through a series of views. The geographic infrastructure enabled by this International Standard will have multiple users, developers, operators and reviewers. Each group will view the system from their own perspective. The purpose of architecture is to provide a description of the system from multiple viewpoints. Furthermore, architecture helps to ensure that each view will be consistent with the requirements and with the other views.

Table 1 shows how the RM-ODP viewpoints are utilized in this International Standard.

Table 1 — Use of RM-ODP viewpoints in this International Standard

Viewpoint Name	Definition of RM-ODP Viewpoint (ISO/IEC 10746-1:1998)	How viewpoint is addressed in this International Standard
enterprise viewpoint	a viewpoint on an ODP system and its environment that focuses on the purpose, scope and policies for that system	This is available in other parts of the ISO 19100 series of standards, e.g., reference model (ISO 19101).
computational viewpoint	a viewpoint on an ODP system and its environment that enables distribution through functional decomposition of the system into objects which interact at interfaces	See Clause 7, computational viewpoint.
information viewpoint	a viewpoint on an ODP system and its environment that focuses on the semantics of information and information processing	See Clause 8, information viewpoint.
engineering viewpoint	a 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	See Clause 9, engineering viewpoint.
technology viewpoint	a viewpoint on an ODP system and its environment that focuses on the choice of technology in that system	See Clause 10 technology viewpoint; also to be addressed by platform-specific service specifications.

The enterprise viewpoint is concerned with the purpose, scope and policies of an enterprise or business and how they relate to the specified system or service. An enterprise specification of a service is a model of that service and the environment with which the service interacts. It covers the role of the service in the business and the human-user roles and business policies related to the service.

The computational viewpoint is concerned with the interaction patterns between the components (services) of the system, described through their interfaces. A computational specification of a service is a model of the service interface seen from a client, and the potential set of other services that this service requires to have available, with the interacting services described as sources and sinks of information.

The information viewpoint is concerned with the semantics of information and information processing. An information specification of an ODP system is a model of the information that it holds and of the information processing that it carries out.

The engineering viewpoint is concerned with the design of distribution-oriented aspects, i.e., the infrastructure required to support distribution. An engineering specification of an ODP system defines a networked computing infrastructure that supports the system structure defined in the computational specification and provides the distribution transparencies that it defines. ODP defines the following distribution transparencies: access, failure, location, migration, relocation, replication, persistence and transaction. Security may also be a mechanism.

The technology viewpoint describes the implementation of the ODP system in terms of a configuration of technology objects representing the hardware and software components of the implementation. It is constrained by cost and availability of technology objects (hardware and software products) that would satisfy this specification. These may conform to platform-specific standards that are effectively templates for technology objects.

In the computational and information viewpoint clauses of this International Standard, specific approaches that shall be followed for defining geographic information services are provided. For the engineering and technology viewpoints, this International Standard defines how a particular service shall be mapped on to an implementation technology, such as SQL-3/ODBC, ODMG, CORBA, DCOM/OLE, Internet or similar technology.

6.3 Service abstraction

This International Standard defines the approach to defining services that shall be used in the ISO 19100 series of standards. Figure 1 defines the relationship between the various types of service specifications. SV_ServiceSpecification defines services without reference to the type of specification or to its implementation. A SV_PlatformNeutralServiceSpecification provides the abstract definition of a specific type of service but does not specify the implementation of the service. Service types are given in the geographic service taxonomy in 8.3. SV_PlatformSpecificServiceSpecification defines the implementation of a specific type of service. There may be multiple platform-specific specifications for a single platform-neutral specification. SV_Service is an implementation of a service. The requirements for these specifications are addressed in this International Standard, in particular in Clause 10.

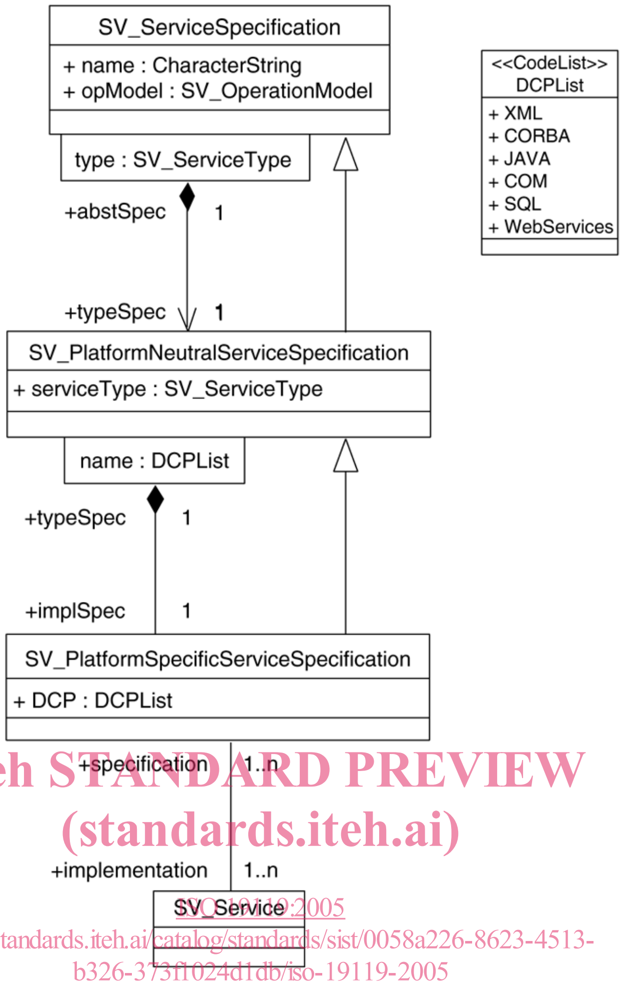

Figure 1 — Abstract and implementation service specifications

6.4 Interoperability

Interoperability is the 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.

Two components X and Y (see Figure 2) can interoperate (are interoperable) if X can send requests R for services to Y, based on a mutual understanding of R by X and Y, and if Y can similarly return mutually understandable responses S to X.

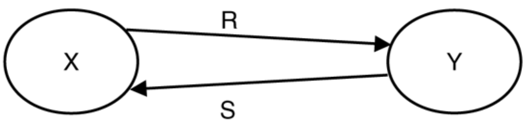

Figure 2 — Interoperability

This means that two interoperable systems can interact jointly to execute tasks. For the geographic domain, the following description of the term “geographic interoperability” is applicable:

“Geographic interoperability” is the ability of information systems to 1) freely exchange all kinds of spatial information about the Earth and about the objects and phenomena on, above, and below the Earth’s surface; and 2) cooperatively, over networks, run software capable of manipulating such information.

The ODP viewpoint abstraction provides a framework for describing a system at several abstraction levels. In this International Standard, interoperability is viewed in terms of the different abstraction levels provided by RM-ODP. This International Standard focuses, from different viewpoints, on how semantic and syntactic interoperability of geographic metadata and geographic data can be supported.

When two different organizations have independently developed distributed systems, each can be described according to the RM-ODP viewpoints, and interoperability between the systems can be discussed with respect to each of the five RM-ODP viewpoints.

For each interoperability aspect, a distinction is made between syntactical interoperability and semantic interoperability. Syntactical interoperability assures that there is a technical connection, i.e. that the data can be transferred between systems. Semantic interoperability assures that the content is understood in the same way in both systems, including by those humans interacting with the systems in a given context.

6.5 Use of other geographic information standards in service specifications

A service specification shall include relevant information models from the appropriate geographic information standards in the ISO 19100 series. The corresponding UML models shall be used in the definition of the service interfaces as appropriate.

6.6 Architecture patterns

An architecture pattern expresses a fundamental structural organization or schema for software services. It identifies a set of services, specifies their responsibilities, and includes rules and guidelines for organizing the relationships between them. Services, implemented by classes and objects, may use design patterns but this level of detail is outside the scope of this International Standard.

The Table 2 provides a listing of the elements of a pattern. When specific architecture patterns are defined in this International Standard, these elements shall be used.

Table 2 — Elements of a pattern

Element of a pattern	Description of element
Name	The name is a word or short meaningful phrase that describes the pattern. The name is extremely important, since it is used to reduce communication overhead. Nicknames or synonyms may be provided.
Problem	This is a statement of the problem which describes its intent, goals and objectives it wants to reach within the given context and forces. Often the forces oppose these objectives as well as each other.
Context	Context defines the preconditions under which the problem and its solution seem to recur, and for which the solution is desirable. This defines the pattern's applicability. It can be thought of as the initial configuration of the system before the pattern is applied.
Forces	The forces are considerations that must be weighed to reach the best solution. Forces define the kinds of trade-offs that must be considered in the presence of the tension or dissonance they create. The forces answer the question: “Why is this a hard problem?”
Structure	Structure defines the static relationships and dynamic rules describing how to realize the desired outcome. The structure description is accomplished through a collaboration diagram.

7 Computational viewpoint: A basis for service chaining

7.1 Component and service interoperability and the computational viewpoint

The computational viewpoint is concerned with describing the entities of a distributed system independent of implementation and semantic content. It describes the interaction patterns between the entities and their interfaces. To be able to interoperate from the computational viewpoints, two systems must be *interface-and-services-interoperable*. Two systems are interface-and-services-interoperable if they agree on the set of services offered by the entities of the two systems and the interfaces to these entities. If standardized interfaces are defined, the entities of one system will be able to request services from entities in another system.

The computational viewpoint clause provides the following:

— defines the concepts of services, interfaces and operations and the relations between these concepts;

— provides an approach to physical distribution of services using an n-tier architecture;

— defines a model for combining services in a dependent series to achieve larger tasks, e.g. service chaining;

— defines a service metadata model to support service discovery through a service catalogue.

7.2 Services, interfaces and operations

Definitions and relationships of several terms are provided in this subclause. These terms are used extensively in this International Standard:

— service: distinct part of the functionality that is provided by an entity through interfaces;

— interface: named set of operations that characterize the behaviour of an entity;

— operation: specification of a transformation or query that an object may be called to execute. It has a name and a list of parameters.

These terms are related to each other as depicted in Figure 3, which shows that services are specified by a set of interfaces that are a set of operations. Interfaces are implemented as ports that make services available to users.