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Geografske informacije – Lokacijske storitve

Geographic information -- Positioning services

Information géographique -- Services de positionnement

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Geographic information — Positioning services

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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

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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 19116 was prepared by Technical Committee ISO/TC 211, *Geographic information/Geomatics*.

Introduction

0.1 General

Positioning services are among the processing services identified in ISO 19119. Processing services include services that are computationally oriented and operate upon the elements from the model domain, rather than being directly integrated in the model domain itself. This International Standard defines and describes the positioning service. Other services in this domain are coordinate transformation, metric translation, format conversion, semantic translation, etc.

Positioning services employ a wide variety of technologies that provide position and related information to a similarly wide variety of applications, as depicted in Figure 1. Although these technologies differ in many respects, there are important items of information that are common among them and serve common needs of these application areas, such as the position data, time of observation and its accuracy. Also, there are items of information that apply only to specific technologies and are sometimes required in order to make correct use of the positioning results, such as signal strength, geometry factors, and raw measurements. Therefore, this International Standard includes both general data elements that are applicable to a wide variety of positioning services and technology specific elements that are relevant to particular technologies.

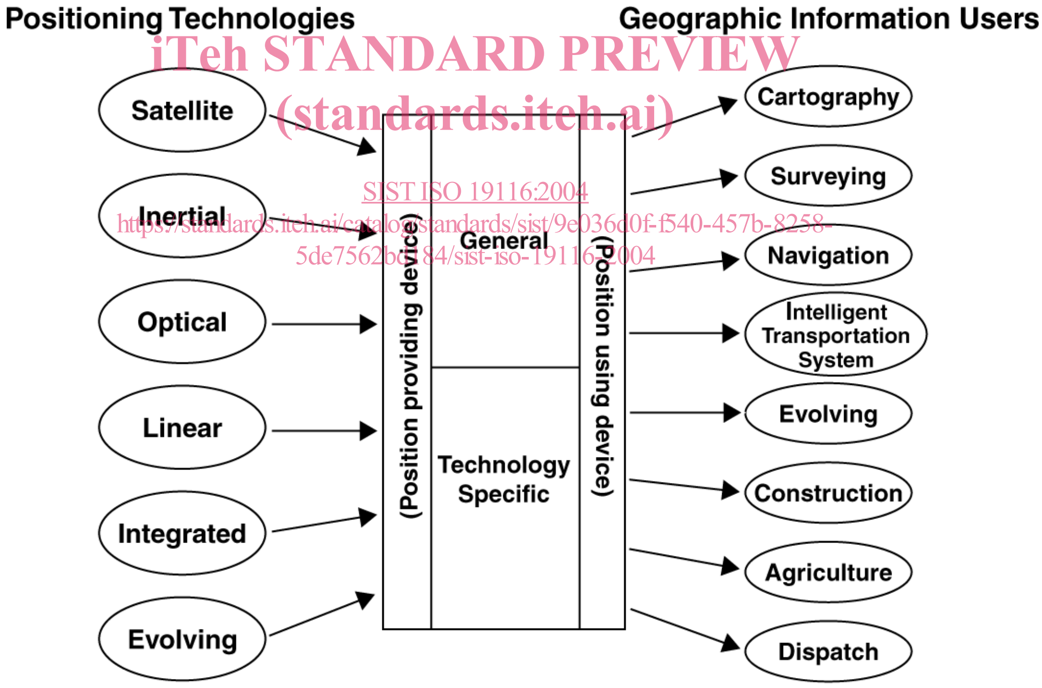

Figure 1 — Positioning services interface allows communication of position data for a wide variety of positioning technologies and users

Modern electronic positioning technology can measure the coordinates of a location on or near the Earth with great speed and accuracy, thereby allowing geographic information systems to be populated with any number of objects. However, the technologies for position determination have had neither a common structure for expression of position information, nor a common structure for expression of accuracy. The positioning-services interface specified in this International Standard provides data structures and operations that allow spatially oriented systems, such as GIS, to employ these technologies with greater efficiency by permitting interoperability among various implementations and various technologies.

This interface may be applied to communication among any of the components of systems that generate and use position information. Such systems may incorporate an instrument providing position updates to one or more position-using devices for data processing, storage, and display. For example, a navigation display system may include recording functions that store the history of a vehicle's movement, processing tools that compute guidance updates along a planned course relying on stored waypoints, and a display device that provides the navigator with current position, computed guidance information, and cartography from stored coordinate information. This International Standard specifies an interface that carries position and related information among any of these components, and should be sufficient for communication between the position providing device and any connected position using devices. Additional interfaces may also exist in such a system, for example providing for cartographic portrayal of stored coordinate information, which are outside the scope of this International Standard.

Standard positioning services provide client systems with operations that access positioning results and related information in a uniform manner, isolating the client from the multiplicity of protocols that may be employed to communicate with the positioning instruments. For example, a realized-positioning service could communicate with a GNSS receiver using the well-known NMEA 0183 protocol, translate the information, and provide the positioning results to a geographic information display client through the ISO 19116 standard interface specified in this document. Another realized-positioning service could communicate with a GNSS receiver using a manufacturer's proprietary binary protocol. Through the use of standardized positioning service interfaces, the hardware communication protocols become transparent to the client application.

Evolution of new communication protocols that closely follow the data structures described in this International Standard is also anticipated. Such communication standards will facilitate efficient fulfilment of the information requirements of the positioning services interface and facilitate modular interchangeability of the positioning technology components.

0.2 Potential use of the service

The application of this International Standard is illustrated in Figure 2 by a simplified case for a user obtaining coordinates from a GNSS receiver.

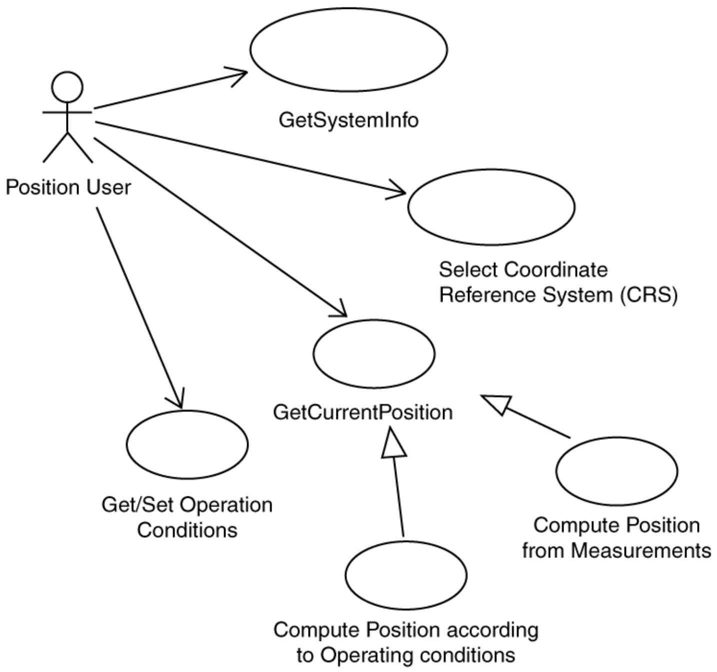

Figure 2 — Use case for getting coordinates from a positioning service

First, the positioning service device transmits system-identification data so that the user can determine the type of positioning system, in this case a GNSS receiver, and whether the system is operational.

Next, the user sets the GNSS receiver to provide coordinates in the desired Coordinate Reference System (CRS) through the interface by performing setMode operations. For instance, the coordinate reference system could be set to NAD27 Virginia State Plane, North Zone, US Survey feet. Note that by using well-recognized CRS names in accordance with the ISO 19111 structure, the user avoids some of the complexity of the definition of the coordinate reference system by using a named datum and mapping projection, and the system interprets these and loads predefined set of parameters.

By performing technology-specific setOperatingConditions operations, the user also sets certain operating conditions of the system so that the position determination will be performed in a desired manner. For example, the user sets the satellite-elevation mask of the GNSS receiver so that satellites that are at low angles in the sky, and consequently, more affected by signal passage through the atmosphere, are excluded from the computation. Certain other operating conditions, such as the current actual positions of available satellites, are not controllable by the user and are determined by the system.

The system then performs measurements according to the operating conditions of the signal from the GNSS satellites and uses these measurements to compute a position cast in the specified Coordinate Reference System.

Finally, the computed position is reported to the user through the PS_Observation data object.

The positioning system also reports on certain operating conditions to help the user decide whether to use the position value. For example, one of the indicators of solution quality is the dilution of precision (DOP) value, which is based on the geometry of the satellites observed to determine the position.

Communication of this information is performed through the standard data structures to the user's display device, which portrays it to the user.

Geographic information — Positioning services

1 Scope

This International Standard specifies the data structure and content of an interface that permits communication between position-providing device(s) and position-using device(s) so that the position-using device(s) can obtain and unambiguously interpret position information and determine whether the results meet the requirements of the use. A standardized interface of geographic information with position allows the integration of positional information from a variety of positioning technologies into a variety of geographic information applications, such as surveying, navigation and intelligent transportation systems. This International Standard will benefit a wide range of applications for which positional information is important.

2 Conformance

This International Standard defines two levels of conformance: Basic (that all implementations shall meet) and Extended (for technology-specific data related to a positioning system). Any positioning services implementation or product claiming conformance with this part of the International Standard shall pass all the requirements described in the corresponding abstract test suite set forth in Annex A.

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 1000:1992, *SI units and recommendations for the use of their multiples and of certain other units*

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

ISO 19108:2002, *Geographic information — Temporal schema*

ISO 19111:2003, *Geographic information — Spatial referencing by coordinates*

ISO 19113:2002, *Geographic information — Quality principles*

ISO 19114:2003, *Geographic information — Quality evaluation procedures*

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
accuracy
closeness of agreement between a test result and the accepted reference value

[ISO 3534-1]

NOTE For positioning services, the test result is a measured value or set of values.

4.2
attitude
orientation of a body, described by the angles between the axes of that body's **coordinate system** (4.5) and the axes of an external **coordinate system** (4.5)

NOTE In positioning services, this is usually the orientation of the user's platform, such as an aircraft, boat, or automobile.

4.3
coordinate
one of a sequence of n numbers designating the position of a point in n-dimensional space

[ISO 19111]

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

4.4
coordinate reference system
coordinate system (4.5) that is related to the real world by a **datum** (4.6)

[ISO 19111]

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

4.5
coordinate system
set of mathematical rules for specifying how **coordinates** (4.3) are to be assigned to points

[ISO 19111]

4.6
datum
parameter or set of parameters that serve as a reference or basis for the calculation of other parameters

[ISO 19111]

NOTE 1 A datum defines the position of the origin, the scale, and the orientation of the axes of a coordinate system.

NOTE 2 A datum may be a geodetic datum, a vertical datum or an engineering datum.

4.7
ellipsoidal height
geodetic height
h
distance of a point from the ellipsoid measured along the perpendicular from the ellipsoid to this point, positive if upwards or outside of the ellipsoid

[ISO 19111]

NOTE Only used as part of a three-dimensional geodetic coordinate system and never on its own.

4.8
geodetic datum
datum (4.6) describing the relationship of a **coordinate system** (4.5) to the Earth

[ISO 19111]

NOTE In most cases, the geodetic datum includes an ellipsoid definition.

4.9
gravity-related height
H
height (4.10) dependent on the Earth's gravity field

[ISO 19111]

NOTE In particular, orthometric height or normal height, which are both approximations of the distance of a point above the mean sea level.

4.10
height
altitude
h
H
distance of a point from a chosen reference surface along a line perpendicular to that surface

[ISO 19111]

NOTE 1 See ellipsoidal height and gravity-related height.

NOTE 2 Height of a point outside the surface treated as positive; negative height is designated as depth.

4.11
inertial positioning system
positioning system (4.21) employing accelerometers, gyroscopes, and computers as integral components to determine **coordinates** (4.3) of points or objects relative to an initial known reference point

4.12
integrated positioning system
positioning system (4.21) incorporating two or more positioning technologies

NOTE The measurements produced by each positioning technology in an integrated system may be of any position, motion, or attitude. There may be redundant measurements. When combined, a unified position, motion, or attitude is determined.

4.13
linear positioning system
positioning system (4.21) that measures distance from a reference point along a route

EXAMPLE An odometer used in conjunction with predefined mile or kilometre origin points along a route and provides a linear reference to a position.

4.14
linear reference system
reference system that identifies a location by reference to a segment of a linear geographic feature and distance along that segment from a given point

NOTE Linear reference systems are widely used in transportation, for example highway names and mile or kilometre markers.

4.15
map projection
coordinate (4.3) conversion from a geodetic **coordinate system** (4.5) to a plane

[ISO 19111]

4.16
motion
change in the position of an object over time, represented by change of **coordinate** (4.3) values with respect to a particular reference frame

EXAMPLE This may be motion of the position sensor mounted on a vehicle or other platform or motion of an object being tracked by a positioning system.

4.17
operating conditions
parameters influencing the determination of **coordinate** (4.3) values by a **positioning system** (4.21)

NOTE Measurements acquired in the field are affected by many instrumental and environmental factors, including meteorological conditions, computational methods and constraints, imperfect instrument construction, incomplete instrument adjustment or calibration, and, in the case of optical measuring systems, the personal bias of the observer. Solutions for positions may be affected by the geometric relationships of the observed data and/or mathematical model employed in the processing software.

4.18
optical positioning system
positioning system (4.21) that determines the position of an object by means of the properties of light

EXAMPLE Total Station: Commonly used term for an integrated optical positioning system incorporating an electronic theodolite and an electronic distance-measuring instrument into a single unit with an internal microprocessor for automatic computations.

4.19
performance indicator
internal parameters of **positioning systems** (4.21) indicative of the level of performance achieved

NOTE Performance indicators can be used as quality-control evidence of the positioning system and/or positioning solution. Internal quality control may include such factors as signal strength of received radio signals [signal-to-noise ratio (SNR)], figures indicating the dilution of precision (DOP) due to geometric constraints in radiolocation systems, and system-specific figure of merit (FOM).

4.20
positional accuracy
closeness of **coordinate** (4.3) value to the true or accepted value in a specified reference system

NOTE The phrase “absolute accuracy” is sometimes used for this concept to distinguish it from relative positional accuracy. Where the true coordinate value may not be perfectly known, accuracy is normally tested by comparison to available values that can best be accepted as true.

4.21
positioning system
system of instrumental and computational components for determining position

NOTE Examples include inertial, integrated, linear, optical and satellite positioning systems.

4.22
precision
measure of the repeatability of a set of measurements

NOTE Precision is usually expressed as a statistical value based upon a set of repeated measurements, such as the standard deviation from the sample mean.

4.23
relative position
position of a point with respect to the positions of other points

NOTE The spatial relationship of one point relative to another may be one-, two- or three-dimensional.

4.24
relative positional accuracy
closeness of **coordinate** (4.3) difference value to the true or accepted value in a specified reference system

NOTE Closely related terms such as local accuracy are employed in various countries, agencies and application groups. Where such terms are utilized, it is necessary to provide a description of the term.

4.25
satellite positioning system
positioning system (4.21) based upon receipt of signals broadcast from satellites

NOTE In this context, satellite positioning implies the use of radio signals transmitted from “active” artificial objects orbiting the Earth and received by “passive” instruments on or near the Earth’s surface to determine position, velocity, and/or attitude of an object. Examples are GPS and GLONASS.

4.26
uncertainty
parameter, associated with the result of measurement, that characterizes the dispersion of values that could reasonably be attributed to the measurand

[GUM]

NOTE When the quality of accuracy or precision of measured values, such as coordinates, is to be characterized quantitatively, the quality parameter is an estimate of the uncertainty of the measurement results. Because accuracy is a qualitative concept, one should not use it quantitatively, that is associate numbers with it; numbers should be associated with measures of uncertainty instead.

4.27
unit of measure
reference quantity chosen from a unit equivalence group

[adapted from ISO 31-0, 2.1]

NOTE In positioning services, the usual units of measurement are either angular units or linear units. Implementations of positioning services must clearly distinguish between SI units and non-SI units. When non-SI units are employed, it is required that their relation to SI units be specified.

4.28
vertical datum
datum (4.6) describing the relation of **gravity-related heights** (4.9) to the Earth

[ISO 19111]

NOTE In most cases, the vertical datum will be related to a defined mean sea level based on water level observations over a long time period. Ellipsoidal heights are treated as related to a three-dimensional ellipsoidal coordinate system referenced to a geodetic datum. Vertical datums include sounding datums (used for hydrographic purposes), in which case the heights may be negative heights or depths.