Chapter 2
Standards and Interoperability

Why Do We Use Standards?

The concept of standards is well known.

Information systems, which include the spatial information systems (GIS, LIS, etc.) should be designed and built based on widely accepted and adopted standards in order to operate properly and efficiently. This principle is the foundation of modern information technology, and without following this principle, the operation of such solutions as e-mail or web sites would not be possible. Standards are the basis for interoperability of information systems and a common denominator for the exchange of information between them.

These rules also apply to the metadata. In order to the metadata could be widespreadily and effectively used, they should be consistent in their form, character, nature and contents.

The metadata developed and applied using various and other than standardised rules cannot be treated as the basis for comparison and objective assessment of quality of spatial data resources, even if the resource features are characterised as accurately as possible by these metadata.

Standards, Norms, Specifications

In everyday use, an understanding and application of concepts such as: standard, norm, specification, and similar, is often not consistent. Therefore, before analysing issues relating to the standardisation of geoinformation metadata, we will discuss definitions of these concepts used in computing and geomatics and rules for the purpose of this publication.

L. Litwin and M. Rossa, *Geoinformation Metadata in INSPIRE and SDI*,
Lecture Notes in Geoinformation and Cartography,
DOI 10.1007/978-3-642-15862-9_2,

Standard and Norm

Standard *in computing is synonymous with norm – a pattern of hardware or software solutions certified by the standardisation institution or informally adopted because of widespread use, in the case of IT standards usually worldwide use*.

According to the Internet Geomatic Lexicon of Polish Association for Spatial Information (http://www.ptip.org.pl), the **standard** is defined in the following way:

1. In a general sense, it is the accepted quality level.
2. In the normative sense, standard is synonymous with **norm** and means a document adopted by agreement, the document which contains rules, guidelines, definitions or criteria that are designed to ensure the quality of materials, products, processes and services.

At the same time, there is a distinction between:

1. ***De jure standards*** developed and approved by the appropriate standards organisations operating at national level (e.g. Polish Standardisation Committee), regional level such as CEN or global e.g. ISO.
2. ***De facto standards*** used because of their popularity and importance on the market, such as ODBC (*Object Database Connectivity*), introduced by Microsoft or WMS (*Web Map Service*) standard published by the OGC.

These definitions make no distinction between the concepts of standard and norm. It should be noted, however, that the term "norm" derives from French, where it is distinguished from the concept of a standard.

In continental Europe (and Poland), where the terminology connected with standardisation is mostly of French origin, the term "norm" is mostly understood as a de jure standard, while the notion of standard means the de facto standard.

An example of such an approach may be the definition of norm provided by PKN (Polish Standardisation Committee) (http://www.pkn.pl). It states that the **norm** is a normative document used on a voluntary basis, commonly available and accepted by a recognised standardisation body. The norm establishes the principles, guidelines or characteristics for various activities and outcomes. It is approved by consensus, and designed for common and repeated use, accepted by all stakeholders as a benefit for all. The norm introduces a code of good practice and principles of rational conduct with the current level of technology.

The provisions of the norm should:

- Be based on sound scientific principles and data verified in terms of technology, economy and utility.
- Take into account the current state of knowledge and level of technology achieved or achievable in the near future.
- Be feasible and absolutely verifiable.

Specification

Overall, the concept of **specification** is defined as (Michalak 2003):

1. Abstract description of programmatic entity (procedure, module, class, object, database, etc.) specifying rules for the use or setting out basic principles for its implementation.
2. Document or a description that specifies in a complete, precise and verifiable way the requirements, design or characteristics of the system or its fragment, and often also the procedures for determining whether those requirements are satisfied.

According to the Internet Geomatic Lexicon of Polish Association for Spatial Information (http://www.ptip.org.pl) **specification** is defined as follows:

1. In computing in general – it means a document or a description that specifies in a complete, precise and verifiable way the requirements, design or characteristics of the system or its fragment, and often the procedures for determining whether those requirements are satisfied.
2. In UML and consequently also in the ISO 19100 series of standards – it means a detailed and complete description identifying "what" something is or "what it is doing".
3. According to the OGC (*Open Geospatial Consortium*) specifications– it means a document developed by a consortium, the technology provider or user. Such a document defines a certain area of technology issues in the field and is primarily intended for developers as a set of guidelines and recommendations for the development of implementation of this technology. The **specification** need not be formally recognised standard (or norm), but usually is submitted as a draft of standard for the official standardisation bodies, such as ISO.

However, following the common use of the concept of norm in Polish standardisation literature, in relation to ***de jure*** standards, the term "**norm**" will be used for standards adopted by technical committees ISO/TC 211, CEN/TC 287 and PN/KT 297(Polish standards). Similarly, the term "pre-norms" will be used for documents, which have not yet been adopted but are currently subject to the development by these committees.

To Whom for a Standard

Computer science, as a field of knowledge, actually does not deal with the spatial aspect of the information. Developing standards for spatial information is the responsibility of Geomatics (geoinformatics) (Michalak 2003), a distinct field of knowledge at the intersection of broadly understood Earth Sciences and computer science.

Many different organisations is involved in developing standards, including legally mandated standardisation bodies, trade associations, initiatives and organisations, non-profit organisations, and even online communities.

These standards are developed mostly within each organisation or group of closely collaborating centres. It also happens that organisations only "endorse" and publish standards, not taking part in their development. An example of such a procedure can be KML (*Keyhole Markup Language*) – language based on XML that allows for visualisation of three-dimensional spatial data, used in applications like: Google Earth, Google Maps, Google Mobile, Live Search Maps, Yahoo Maps, and NASA World Wind.

KML was developed by Keyhole, Inc., implemented by Google and endorsed by the OGC (*Open Geospatial Consortium*) as the OpenGIS standard.

Two international organisations remain leaders in developing standards for geoinformation: OGC (*Open Geospatial Consortium*) and one of ISO technical committees – ISO/TC 211. The roles of these organisations in the standardisation process are different. OGC deals with issues of technology and practical implementation, and ISO with the more formal and procedural approval of standards as the official documents (Michalak 2003).

Therefore, in practice, OGC develops technical specifications and the ISO/TC 211 approves them as international standards – ISO 19100 series. Roles of the standardising organisations and the relationships between standards will be described later in this book.

Because of the growing interest in geoinformation and its wider and deeper relations with the world of the Internet and mobile technologies, close co-operation of geomatic centres with organisations involved in standardising solutions for the Internet (W3C) and e-business (e.g. OASIS) becomes increasingly important. ebRIM standard for metadata catalogues developed by OGC in collaboration with the OASIS is an example of such co-operation.

Standardisation Organisations in the Field of Geoinformation (Geomatics)

ISO: International Organisation for Standardisation (http://www.iso.org)

ISO officially began operation on 23 February 1947. Before, the ISO was a non-governmental, international standard organisation responsible for promoting and developing standards that facilitate international exchange of goods and services.

ISO brings together national organisations for standardisation. Governments, despite the fact that some member organisations are part of governmental structures do, not delegate members of the ISO. This puts ISO in a special position between the state and private sector, particularly the industrial associations. Each country is represented, in principle, by only one organisation. Currently, ISO members represent 160 countries. One of founding members of ISO is Polish Committee for Standardisation (PKN).

Membership fees, proportionally to the gross domestic product of a country finance ISO activities. Sale of publications, including standards brings additional income.

Respecting ISO standards (norms) is voluntary. As a non-governmental organisation ISO can not impose or enforce their use. The authority of the organisation stems from the international representation, establishing standards by consensus, and from understanding the influence of standardisation on markets and economy.

There are hundreds of technical committees and working groups developing the individual standards within ISO. One of the Technical Committees is ISO/TC 211, which aims to develop and implement standards (norms) for geographic information and geomatics. (Wikipedia)

ISO/TC 211 Technical Committee: Geographic Information/Geomatics (http://www.isotc211.org/)

Technical Committee operating within ISO structures, which work aims to establish a structured set of standards (norms) for information concerning objects or phenomena that are directly or indirectly related to the location in relation to the Earth. Committee headquarters are located in Norway. ISO/TC 211 programme of work includes the preparation of over 50 standards for spatial information and geomatics – ISO 19100 series of standards. These standards specify methods, tools and services related to the spatial data management (including the definitions and descriptions): harvesting, processing, analysing, access, presentation and transmission of such data in electronic form between users of different systems.

In addition to the standardisation work ISO/TC 211 teams work on ontological and semantic aspects of spatial information.

Many organisations are actively involved in the work of ISO/TC 211 Technical Committee. These include CEN – European Committee for Standardisation, the national bodies for standardisation including PKN, OGC, UN agencies and international professional organisations (e.g. FIG (http://www.fig.net) and ICA (http://www.ica.org)) and special interest organisations (e.g. DGIWG (http://www.dgiwg.org) and ICAO (http://www.icao.int)).

OGC: Open Geospatial Consortium (http://www.opengeospatial.org)

The international consortium of more than 400 parties from around the world: commercial organisations, government agencies, non-profit organisations and universities. OGC is not a standards organisation.

OGC was established in 1994, but until 2004 the organisation was known as the Open GIS Consortium.

> Currently, the only member of the OGC from Poland is Polish Association for Spatial Information (PASI), which joined the consortium in 2006. Until then this role was performed by the University of Warsaw, which joined the OGC in 1997, in the period when the consortium began operations, and was the first organisation from Eastern Europe to become OGC member.

The main task of OGC is to develop agreed and accepted specifications for interoperability issues in the field of geoinformation, i.e. the ability of systems to work together. This scope is very widely understood. Thus, specifications concern very general conceptual models as well as detailed technical documents for specific implementations (Michalak 2008).

OGC works closely with organisations such as ISO (TC 211), W3C, OASIS, IETF and WfMC. It also has a branch in Europe – OGC Europe.

CEN: European Committee for Standardisation (http://www.cen.eu)

(french: Comité *Européen de Normalisation*)

Private technical association which is a non-profit organisation, operating under Belgian law with its seat in Brussels. CEN was founded officially in 1974, but the beginnings of the committee go back to 1961 in Paris.

The primary task of CEN is to develop, adopt and disseminate European norms (EN) and other standardisation documents in all areas of the economy with the exception of electrical engineering, electronics and telecommunication. CEN standardisation system is a multinational, multidisciplinary and decentralised organisation.

CEN members are the national standards bodies of the European Union countries and European Free Trade Association (EFTA) countries. Currently, CEN has 30 members. One of them is Polish Committee for Standardisation (PKN), which was

granted full membership on 1 January 2004. CEN Members are obliged to introduce European EN standards into their national standards systems and to withdraw existing national standards conflicting with the EN standards. These rule leads to a common system of European solutions. European Standards are one of the foundations of the Single Market and important tool in removing trade barriers within the EU.

CEN works closely with CENELEC (European Committee for Electrotechnical Standardisation), ETSI (European Telecommunications Standards Institute) and ISO.

There are many technical committees within CEN, one of which is the Technical Committee CEN/TC 287 Geographic Information – which deals with standards in the field of spatial information.

Technical Committee CEN/TC 287: Geographic Information

Most activities of CEN/TC 287 can be described by quoting the document "Business Plan of CEN/TC 287" dated March 10, 2008:

The main objective is "to facilitate the building of the infrastructure for spatial information in Europe by:

1. Voting on the adoption of ISO 19100 series of standards as CEN standards.
2. Developing new standards, specifications and profiles of standards that underpin INSPIRE implementing rules as they become available.
3. Developing new standards, specifications and technical reports as necessary.
4. Ensuring interoperability by co-operation in particular with ISO/TC 211, the technical co-ordinator of INSPIRE and OGC.
5. Establishing the basic principles for implementation of cultural and linguistic adaptability in CEN member countries; and by researching the possibility of funding with the EU 7th Framework programme for project work that is essential to Europe.
6. Promoting the use of and education on standards for geographic information."

PKN: Polish Committee for Standardisation (http://www.pkn.pl)

The Polish national standard organisation (PKN) is financed from a state budget. PKN was established in 1924, and in the years 1972–1991, together with the Central Office of Weights and Measures formed the Polish Committee for Standardisation and Quality Measurement. The legal basis of PKN activities in the current scope is the Act of 12 September 2002 on standardisation (Journal of Laws – Dz.U. No.169 of 2002, pos. 1386).

Since 1991, PKN (then PKNMiJ) was an affiliate of CEN (European Committee for Standardisation) and CENELEC (European Committee for Electrotechnical Standardisation), and on 1 January 2004 became a full member of both institutions.

The PKN basic activities are carried out in the areas of:

- Determining the status and trends in development of standardisation
- Organising and supervising activities related to the development and dissemination of Polish Norms (PN) and other standardisation documents
- Approving and withdrawal of PNs and other standardisation documents
- Representing the Republic of Poland in international and regional standards organisations
- Initiating and organising the work of technical committees to perform tasks related to the development of standards
- Organising and conducting training, publishing, promotional and informational activities regarding standardisation and standardisation related fields
- Giving opinions on draft legislation related to standardisation

Additionally, PKN is required to introduce European EN norms to the system of national standards and withdraw existing PN norms conflicting with EN standards.

One of the many technical committees of the PKN is the Technical Committee PKN/KT 297 for Geographical information (http://www.pkn.pl).

The Technical Committee PKN/KT 297 for Geographic Information (http://www.gugik.gov.pl/kt297/)

The Technical Committee is an organ of Polish Committee for Standardisation, acting within the scope of financial, housing and organisational resources of Head Office of Geodesy and Cartography (GUGiK). Secretariat of KT 297 operates under an agreement between PKN and GUGiK and within the GUGiK's structures.

Scope of PKN/KT 297 work covers all issues related to modelling and design of data resources in spatial information systems and also to spatial information flow between different users and systems. It has been determined in detail in the "Programme of standardisation work in the field of geographic information" accepted on 16 February 2002 (Pachelski 2002). Main objectives of standardisation activities in the KT 297 for geographical information are:

- Enhancing the value and utilisation of geographic information in various fields.
- Increasing the accessibility of geographic information and facilitating access to this information for various users, as well as facilitating building relations (integration) with other types of information.
- Organising concepts and terminology for the development of foundations for an information communication.
- Preparing appropriate foundations for designers of information systems related to geographic information.
- Facilitating the efficient circulation of geographical information.
- Taking part, through co-operation with international and European standardisation organisations, in the co-ordinated development of the international information community.

In addition, one of the main tasks of this committee, under the obligations to the EU, is introducing European standards EN-ISO in the field of geomatics and spatial information into the system of national standards and withdrawal of the existing PN norms conflicting with EN-ISO standards.

In the case of geo-information, this means introducing ISO 19100 series of standards, adopted by the CEN as European standards EN-ISO.

PKN/KT 297 committee also runs a web portal containing an electronic version of the terminology guide (e-Guide) to the Polish Norms in the field of geographical information (http://e-przewodnik.gugik.gov.pl).

W3C: World Wide Web Consortium (http://www.w3c.org)

Organisation for the development of interoperable standards, enabling the exchange of online information, including standards for developing and transmission of Web pages. Tim Berners-Lee, creator of the first web browser and World Wide Web (WWW) established the W3C in 1994.

Today, W3C brings together more than 300 different organisations, businesses, government agencies and universities from around the world. Specifications published by the W3C (which in this case are the de facto recommendations) have no legal force mandating their use, but the influence of the organisation makes them count. Most of common protocols and definitions for the Internet are established and maintained by the W3C, such as XML, XML Schema, WSDL, RDF, HTML, CSS, etc.

OASIS: Organisation for the Advancement of Structured Information Standards (http://www.oasis-open.org)

An international non-profit consortium involved in the development of standards for e-business, including Web standards. OASIS was founded in 1993 under the name SGML Open, to promote SGML language (*Standard Generalized Markup Language*). Organisation name was changed in 1998 to reflect the widening area of operations. The OASIS has more than 5,000 participants from over 100 countries, including more than 600 organisations. OASIS is co-operating closely with OGC in the field of geoinformation.

Decision are made by members of the consortium in an open and democratic way. Current work includes such issues as web services, e-commerce, security, law and administration, applications, documents, XML transformations or compliance and co-operation.

OASIS standards include:

- SAML (Security Assertion Markup Language) – XML-based standard for the secure exchange of information on authentication and authorisation.

- XRI (eXtensible Resource Identifier) – naming scheme and resolution protocol of abstract identifiers compatible with URI, used to identify and share resources across domains and applications.
- XDI (XRI Data Interchange) – a standard for sharing, linking and synchronising data between multiple domains and applications using XML documents, XRI identifiers and link contract method.
- OpenDocument – an open XML-based format for office documents such as text documents, spreadsheets, charts and presentations.

DCMI: Dublin Core Metadata Initiative (http://dublincore.org)

This initiative is an open organisation involved in the development of interoperable metadata standards for the Internet, that offer a wide range of purposes, data and business models.

DCMI established the Dublin Core standard (Dublin Core Metadata Element Set, DC, DCES) – a general metadata standard, adopted as ISO 15836-2003. This standard defines 15 simple elements for resource description (e.g. library resources). These elements may be encoded in various formats such as RDF (***Resource Description Framework***) or HTML/XHTML. Dublin Core standard of description is used for example in digital libraries of dLibra system.

How Geoinformation Standards Are Developed

Initial work on geoinformation standards began in Europe in early 1990s of the twentieth century. In 1991, CEN Technical Committee TC 287 was established, which started work on the development of European standards in the field of geoinformation. Only a year later came the idea of OpenGIS (beginnings of OGC), initiated among the authors of the GRASS-GIS system from U.S. Army CERL research centre.

In October 1994, OGC was founded, and in November of that year ISO/TC 211 was formed. In the mid 1990s, ISO standards and specifications of OGC were only just developing, and their preliminary nature did not allow for practical applications, while the CEN/TC 287 norms had already provided sufficiently formal basis for the design of spatial information systems. That's why the development of projects in European Union was based on those standards.

The next 3 years (1994–1997) were a period of very intensive work in both ISO/TC 211 and OGC, but carried out separately. As a result, delay in relation to Europe was recuperated, but two different approaches to the same issues were developed (Kuhn 1997). Therefore, October 1997 saw the beginning of a close collaboration between the OGC and ISO/TC 211. One of its objectives was to achieve full compliance of developed geoinformation standards.

In 1997 standards developed by CEN/TC 287 began to be published as "pre-norms" ENV, with a validity of 3 years. At that time, standards of ISO/TC 211 and

OGC specifications were becoming increasingly important. In Europe, discussions began whether, if ISO develops so highly rated international standards, there is a need to develop separate European standards. The need for standardization in the field of geoinformation in Europe and adoption international ISO standards was also confirmed by EU research projects such as Cast (*GIS Interoperability Project Stimulating Industry in Europe*) – June 1998. On the other hand there were questions "Why should we give up our already developed CEN/TC 287 norms for the unfinished and foreign documents?" and the opinions that "OpenGIS is the economic aggression of American capital on the European geoinformation market". The whole situation was complicated by the fact that European geoinformation sector was much less integrated than the similar sectors in other regions of the world, and therefore it was much more difficult to reach a consensus on matters of generally accepted standards. Furthermore, various European countries began to use various combinations of standards: national, European, ISO and OGC.

Finally, pragmatism and common sense prevailed. The committee, at its meeting of CEN/TC 287 in Vienna in November 1998, decided not to approve ENV pre-norms as norms. Instead, the committee undertook resolutions on the adoption of ISO/TC 211 standards as European norms (15/123) and on "suspending" the work of the technical committee CEN/TC 287 (15/129). These decisions were preceded, in September 1998, by the appointment of a special group for Europe in the OGC – Europe OGC SIG (*Special Interest Group Europe OGC*). And in February 1999, work on the OpenGIS standards began in Joint Research Center (JRC) – European Commission research institute in Ispra (Italy).

Beginning of the twenty first century is a period of further strengthening of co-operation between the EU, ISO/TC 211 and OGC. One of the results of this collaboration was the creation, in June 2001, of OGC Europe based in London. Also, ISO/TC 211 committee began to use achievements of the CEN/TC 287 during development of ISO 19100 series.

In Poland, a new Technical Committee PKN/NKP 297 was appointed (now PKN/KT 297) in June 2001 as part of PKN, with the aim of developing Polish geoinformation standards.

In April 2002, INSPIRE (Infrastructure for Spatial Information in Europe), the initiative of building a European infrastructure for spatial information about the environment, was officially launched. It is the largest and most serious action of the EU so far, resulting from the decisions of the adoption of ISO/TC 211 standards as European norms. INSPIRE is to be based on ISO 19100 series of standards and the OGC specifications.

Also in April 2002, the first Polish spatial data norm based on the European pre-norms ENV CEN/TC 287 was developed by PKT/TK 297. At that time, the above mentioned standards were already obsolete for more than 2 years (in fact after the decisions taken at the Vienna meeting, they were only of historical significance) and CEN/TC 287 committee had been suspended for 2 years. At the same time, the whole geoinformation world was adopting ISO standards, and the European Union began the construction of INSPIRE, based on ISO standards and OGC specifications.

It should be strongly emphasized, that actions then undertaken by PKN/TK 297 committee were recognised by more advanced part of the Polish geoinformation community as regressive and restraining the development of Polish geoinformation (Gaździcki 2002).

In 2003, new circumstances, external conditions and the reform of the Polish national standardisation activities led to the need for far-reaching review and modifications of the scope, programme and forms of PKN/KT 297 activity. These new circumstances and conditions included:

- QQ full membership of Poland in the CEN as of 1 January 2004, which requires European norms to be introduced as Polish Norms, including ISO 19100 series standards adopted as European norms.
- Intensification of work on the INSPIRE.
- Reactivation of the Technical Committee CEN/TC 287 Geographic information, as the authority responsible for building standardisation infrastructure in this field in Europe, necessary to achieve the objectives of INSPIRE.
- Adoption by CEN/TC 287 of international ISO standards in the field of geographic information as a basis for building a system of European standards in this field.
- Introduction of a new law on standardisation, which strengthened the role and importance of national Technical Committees for the economy and provided for their closer ties with the manufacturing practice.
- And also, Polish membership in the European Union since May 1, 2004 (http://www.Gugik.gov.pl/pkt297/).

Observing the intensity of the work carried out in recent years both in Europe and in Poland regarding standards for geoinformation, we can be sure that these initial problems have been completely resolved. In 2007, the INSPIRE Directive was adopted and first guidelines for its implementation were published. Intensive work on the remaining technical guidelines is still in progress. In addition, proposal of the Act of Parliament on the Polish spatial data infrastructure, which transposes the provisions of the INSPIRE Directive into national law, is nearing completion along with the relevant regulations.

> All these legal solutions involve the use of adequate standards: OGC specifications and ISO 19100 series of standards – adopted as European norms CEN/TC 287 or national norms.

The only point that may raise some concern is the question whether the Polish geoinformation sector and the market are adequately prepared for the challenges and responsibilities arising from the need to implement these standards.

The development of geoinformation standards has not yet been completed and even if we take into account just the further evolution and development of information systems we should not assume that it will ever end. This process occurs on

many mutually inter wining areas, one of which concerns further development of already adopted standards. Another area is the development of new standards and ensuring full compatibility across all geoinformation standards. It is also very important to implement solutions that meet the requirements of standards in other fields.

Example of using UML (Unified Modeling Language) – Collaboration Diagram: Use Case View -> three-level model of standardization and development work on interoperability in geospatial information and geomatics (elaborated in UML on the basis of ISO/TC 211 and OGC documents).

level of ISO/TC 211 standardisation work
<<using UML>> ISO 19100 base standards: norm
<<using UML>> adapted extensions: norm
OGC specifications level (OpenGIS)
basic model

1. (OGC resolutions) Requests for standards
2. Additions and improvements
3. (Resolutions of ISO/TC 211)
4. RFP Procedures
5. Additions and improvements

<<using UML> Abstract specification topics: Abstract specification
<<UML not required>> OGC specifications: Implementation specification
The level of the general implementation work
<<UML not required>> Implementations, services and languages: Application

6. Development
7. Revision Procedures

This work is underway both in the OGC and in the ISO/TC 211. The two organisations co-operate closely in this area, as well as with other standardisation organisations such as W3C, OASIS and DCMI. As a result of this collaboration, most of the abstract specifications developed by the OGC has undergone formal procedures in ISO/TC 211 and has been approved and published as ISO 19100 series standards.

By the end of April 2010 ISO/TC 211 technical committee had published and approved 30 standards and 7 technical guidelines and technical reports. In addition, committee is working on more then 14 new standards, which are in varying stages of completion (Table 2.1).

The process of co-operation between the OGC and ISO/TC 211 is presented on a model of standardisation work in these organisations (Fig. 2.1).

Table 2.1 Comparative table of the ISO series 19100 and PN or EN standards

ISO 19101: 2002 *Reference* Model
PN-EN ISO 19101:2005 English
Norm – defines the scope of the 19100 series of standards and the division into sub-scopes, objectives and means of implementation, it provides the basic terms and relationship to other documents, standards and specifications. It is an introduction and guide to the ISO 19100 series of standards for geospatial information, which enable the widespread use of digital geoinformation
ISO **19101–2**: 2008 *Reference* model – Part 2: *Imagery*
No EN or PN standards
Technical Specification – defines a reference model for standardisation in the field of geospatial imagery. Describes a reference model including grid type data, with emphasis on aerial photographs and satellite images
ISO 19102 *Overview*
No EN or PN standards
The project discontinued in 2001
ISO **19103**: 2005 *Conceptual schema language*
No EN or PN standards
Norm – describes the UML (*Unified Modelling Language*) as chosen by ISO/TC 211 for conceptual schemas. Specifies the UML Profile for spatial information. Provides rules and guidelines for the use of UML conceptual diagrams in ISO standards for geospatial information. Planned completion date of draft for EN standard: October 2010
ISO **19104**: 2008 *Terminology*
No EN or PN standard
Norm – applicable to international communication in the field of spatial information. Provides guidelines for the collection and maintenance of terminology in the field of geoinformation. Establishes criteria for the selection of concepts to be covered by other standards for geospatial information (developed by ISO/TC 211), specifying the structure of the terminology and rules for the description and definition writing. This document includes a set of 11 metaterms and 1488 terms, 793 of which refer to definitions, and many symbols, abbreviations and acronyms. No information about the start of work on the drafts of EN or PN standards
ISO **19105**: 2000 *Conformance and testing*
PN-EN ISO 19105:2005 English
Norm – provides guidelines, concepts, criteria and methodology for verifying conformance of geospatial data, IT products and services and specifications, including profiles and functional standards to ISO standards for geospatial information. The standard defines two classes of conformance: conformance of the specifications to ISO standards series for geographic information and conformance of chapters regarding compliance with the provisions of ISO 19105. This document also sets the rules for defining abstract conformance testing, and testing procedures. In addition, the standard includes descriptions of identified types of conformance tests, conformity assessment processes and discussion on the methodology of testing
ISO **19106**: 2004 *Profiles*
PN-EN ISO 19106:2006 English
Norm – defines a concept of a profile of the ISO geographic information standards (developed by ISO/TC 211) and gives guidance for the creation of such profiles. According to this standard, only those components of specification, corresponding to the profile definition given by the standard, may be established and applied through the mechanisms described in the standard. These profiles may be standardised internationally. The standard also provides guidance for establishing, managing, and standardising at the national level
ISO **19107**: 2003 *Spatial schema*
PN-EN ISO 19107:2010 English

(continued)

Table 2.1 (continued)

Norm – specifies conceptual schemas to describe the spatial characteristics of geographic features and to manipulate these characteristics. Features of objects are described only by the vector data. Geometrical models covered by this standard provide means for quantitative descriptions of spatial features, using the co-ordinates and mathematical functions. Topological models described in the standard provide means for qualitative descriptions of the spatial characteristics of geographic features and relationships between them

ISO **19108**: 2002 *Temporal Schema*

PN-EN ISO 19108:2010 English

Norm – defines concepts for describing temporal characteristics of geographic information. Defines the (conceptual) model of time for spatial information in which it provides: temporal geometric primitives and temporal topological objects, temporal location and temporal reference systems. It provides basis for defining temporal attributes, operations and relations of spatial objects, as well as temporal elements of geoinformation metadata

ISO **19109**: 2005 *Rules for application schema*

PN-EN ISO 19109:2009 English

Standard – defines the rules for creating and documenting application schemas, including rules for the definition of features. Includes: conceptual modelling of features and their properties from a universe of discourse; defining application schemas, use of conceptual schema language for application schemas, the integration of standardised schemas from other ISO geographic information standards with the application schema

ISO **19110**: 2005 *Feature Cataloguing Methodology*

PN-EN ISO 19110:2010 English

Norm – defines a methodology for cataloguing feature types and specifies how the classification of feature types is organized into a feature catalogue and presented to users of spatial data resources. This methodology is applicable to creating catalogues of feature types in previously uncatalogued areas, as well as to revising the existing feature catalogues to comply with standard practice

ISO **19111**: 2007 *Spatial referencing by co-ordinates*

PN-EN ISO 19111:2007 English

Norm – outlines the elements necessary to fully define the different types of co-ordinate reference systems applicable in geoinformation. It also describes the co-ordinate transformations and conversions between different co-ordinate reference systems. The annexes to the standard describe procedure for verifying compliance of the reference system description with the standard and provide example descriptions of reference systems. Extensive explanations of some terms used in the standard are also provided

ISO/PRF **19111-2** *Spatial referencing by co-ordinates – Part 2: Extension for parametric values*

No EN or PN standards

The draft standard – defines the conceptual schema for describing the spatial references using the parametric values or functions. It applies the schema of ISO 19111 to combine a position referenced by co-ordinates with a parametric value to form a spatio-parametric co-ordinate reference system (CRS), which can optionally be extended to include time. Draft ISO standard – planned completion date: 12.2009

ISO **19112**: 2003 *Spatial referencing by geographic identifiers*

PN-EN ISO 19112:2005

Standard – defines the conceptual schema for spatial references based on geographic identifiers. It establishes a general model for spatial referencing using geographic identifiers, defines the components of a spatial reference system and essential components for gazetteer services. This document is in some way helps users understand the application of spatial references for the

(continued)

Table 2.1 (continued)

data. It is applicable to digital geospatial data, but its principles can be extended to other types of information such as maps, charts, text documents

ISO **19113**: 2002 *Quality Principles*

PN-EN ISO 19113:2009 English

Standard – defines a schema for assessing the quality of spatial data: data sets series, data sets and subsets. It defines the essential measurable and not measurable components of geographic data quality and lays down principles of organisation of information about the quality of data sets. The standard provides general guidelines for recording information about the quality. The standard is designed for producers of spatial data sets providing information on product quality and for users who want to check to what extent the product meets their expectations

ISO **19114**: 2003 *Quality Evaluation Procedures*

PN-EN ISO 19114:2005 English

Standard – provides guidance on procedures for the evaluation of measurable quality of geospatial data sets according to the quality model specified in ISO 19113. The document contains description of the 5-phase process of quality assessment, categorised quality assessment methods and procedures for assessing the quality of geographic data. In addition, it includes tips for recording the results of quality evaluation of geospatial data directly in metadata and in the external report. The standard is applicable for producers of geographical data sets, which supply information about the degree of conformity of data sets with the product specifications as well as for data users who wish to verify that the set contains data of adequate quality. Following documents complement the standard: ISO 19114:2003/Cor 1:2005 (PN-EN ISO 19114:2005/AC:2006)

ISO **19115**: 2003 *Metadata*

PN-EN ISO 19115:2005 English

Norm – provides the structure for the description of spatial data set and spatial services. It defines the metadata (data about data) to record information about the identification of geospatial data sets, data quality and coverage, applied spatial and temporal schemes, systems of reference and principles of dissemination and sharing digital spatial data. It presents the conceptual metadata schema, indicating mandatory, optional and conditional metadata elements. The document establishes common terminology for metadata and provides mechanisms for extending the normative metadata with new elements in order to meet the specific information needs of users of the standard. Metadata schema is presented in the form of UML class diagrams complemented with tabular description in a normative Annex B. The standard is intended for systems analysts, designers, systems programmers and anyone interested in the basic principles and requirements for the standardisation of spatial information. The document relates primarily to digital spatial data, but can also be applied to many other forms of spatial data, such as paper maps, charts and text documents as well as for non-geographic data. Following documents complement the standard: ISO 19115:2003/Cor 1:2006 (PN-EN ISO 19115:2005/AC:2008). Completion of Polish language version is planned for November 2010

ISO **19115**–2:2009 *Metadata – Part 2: Extensions for imagery and grid type data*

No EN or PN standard

Norm – extends the existing geographic metadata standard by specifying schema required for describing the gridded data and imagery: aerial photographs and satellite images. The schema contains information about the properties of measuring devices used for data acquisition, the geometry of the measuring process and the production process including raw data digitisation. The work on draft EN standard is under way – planned completion: February 2010. No information about the start of work on the PN draft

ISO **19116**: 2004 *Positioning services*

PN-EN ISO 19116:2006 English

(continued)

Table 2.1 (continued)

Norm – defines the data structure and content of an interface to allow communication between the position-providing devices and the devices using this position, to permit a consistent interpretation of information about the location and to determine whether results meet the requirements of use. A standardised 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

ISO **19117**: 2005 *Portrayal*

PN-EN 19117:2010 English

Standard – defines a schema that describes the portrayal of geographic information in a form understandable by humans. It includes the methodology for describing symbols and mapping of the schema to an application schema. This does not include standardisation of cartographic symbols and their geometric and functional description

ISO **19118**: 2005 *Encoding*

PN-EN ISO 19118:2006 English

Standard – specifies the requirements for defining encoding rules to be used for the exchange of spatial data within ISO international standards: creating encoding rules based on UML schemas, creating encoding services and non-regulatory, XML based encoding rule for platform-independent exchange of spatial data. The document provides rules, which are consistent with conceptual schemas used for storage or transmission, and definitions of the mapping between the language of conceptual schemas and storage rules. The document does not specify any digital media services do not define any transmission or communication protocols, nor does it specify how the on-line coding of large images

ISO **19119**:2005 *Services*

PN-EN ISO 19119:2010 English

Norm – identifies and defines the architecture patterns for service interfaces used for geographic information. It presents a geographic services taxonomy and a list of example geographic services placed in the services taxonomy. It contains guidelines for for the selection and specification of the geospatial services both in terms of platform-independent services, as well as specific services for specific platforms. It also defines its relationship to the Open Systems Environment model (OSE)

ISO/TR **19120**:2001 *Functional standards*

No EN or PN standards

Technical report – regards identifying areas in which development of ISO standards should be influenced by experience of sectors where these standards are applied. No information about the initiation of work on PN and EN draft standards

ISO/TR **19121**: 2000 *Imagery and gridded data*

No EN or PN standards

Technical report – regards treatment of images and grid type data(matrix) in the context of their application for graphical information and geomatics. No information about the initiation of work on EN or PN draft standards

ISO/TR **19122**: 2004 *Qualification and certification of personnel*

No EN or PN standards

Technical report – on an organisational system for the qualification and certification of personnel in the field of Geographic Information/Geomatics. No information about the initiation of work on EN or PN draft standards

ISO **19123**: 2005 *Schema for terrain coverage geometry and functions*

PN-EN ISO 19123:2010 Polish

Standard – defines a conceptual schema for the spatial characteristics of terrain coverage. This coverage supports mapping from a spatial, temporal or spatiotemporal domain to feature

(continued)

Table 2.1 (continued)

attribute values, where feature attribute types are common to all geographic positions within the domain. A coverage domain consists of a collection of direct positions in a co-ordinate space, which can be defined in up to three dimensions, as well as a temporal dimension. Examples of coverage include raster, triangulated irregular networks, points and polygon of coverage.

Standard conception schema for description of spatial characteristics of terrain coverage

ISO **19124** *Imagery and grid data components*

No EN or PN standards

Concepts for the description and representation of imagery and grid data in the context of other standards of this group. The project has closed

ISO **19125-1**: 2004 *Simple feature access – Part 1: Common architecture*

PN-EN ISO 19125-1:2006 English

Standard establishes a common, coherent structure of simple geometric objects and defines terms to use within this structure. Standardises the names and definitions of geometric types. It does not include requirements on how to define geometry types in the internal schema. Implements the spatial profile of the schema described in EN-ISO 19107. Annex A (informative) presents a relationship between common architecture concept established in this standard and the concepts of geometrical models according to EN-ISO 19107. Polish language version of that standard is under development – planned completion date: September 2010

ISO **19125-2**: 2004 *Simple feature access – Part 2: SQL option*

PN-EN ISO 19125-1:2006

Standard specifies an SQL schema that supports the storage, retrieval, query and update of simple geospatial feature collections via SQL Call Level Interface (SQL/CLI) (ISO/IEC 9075-3:2003). It also establishes architecture for the implementation of feature tables. Defines terms to use within the architecture. Defines the profile of EN-ISO 19107 for simple features. It describes a set of geometric data types for SQL (Geometry Type). This part of ISO 19125:2004 does not attempt to standardise and does not depend upon any part of the mechanism by which Types are added and maintained in the SQL environment, including the following:

- The syntax and functionality provided for defining types
- The syntax and functionality provided for defining SQL functions
- The physical storage of type instances in the database
- The specific terminology used to refer to User Defined Types, for example, UDT

Polish language version of that standard is under development – planned completion date: November 2010

ISO **19126** *Feature concept dictionaries and registers*

PN-EN ISO 19126:2009

Standard – a document defines the profile based on a feature dictionary and feature attributes defined in the DIGEST standard

ISO/TS **19127**: 2005 *Geodetic codes and parameters*

No EN or PN standard

Technical Specification – defines the rules for developing a single international database of reference systems and the spatial projections. It specifies rules for the operation and maintenance of registers of geodetic codes and parameters and identifies the data elements in accordance with ISO 19135 and ISO 19111, required within these registers. No information about the work on EN or PN standards

ISO **19128**:2005 *Web Map Server Interface*

PN-EN ISO 19128:2010 (Polish)

Standard – specifies the behaviour of a service that produces spatially referenced maps dynamically from geographic information. "Map" presents geographic information as a digital image stored in file in the form appropriate for display on the monitor screen. Maps produced

(continued)

Table 2.1 (continued)

by WMS are provided in the form of raster file such as PNG, GIF, JPEG, or less frequently – in the form of vector graphics SVG or WebCGM. Map is not data, therefore, WMS may not be used as a source of current feature data or coverage. Standard defines three operations: – GetCapabilities – to obtain a detailed description of the maps available on the server – GetMap – to retrieve maps, and – GetFeatureInfo – to query the server for attributes of features displayed on the map. GetCapabilities and GetMap are mandatory and therefore must be implemented in any WMS service. HTTP protocol and HTTP GET method as a basic mechanism of communication between the client and the WMS server. It makes possible sharing maps via the Internet, including the creation of maps based on queries in the form of images, set of graphical elements or set of data relating to the selected features

ISO/TS **19129**:2009 *Imagery, gridded and coverage data framework*

No EN or PN standard (English)

Technical specification – framework for the description and representation of images, grid data and coverage. No information about the initiation of work on EN or PN draft standards

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

No EN or PN standards (English)

Technical specifications – the sensor model describing the physical and geometric properties, as well as data for the sensors to obtain information in the form of images and grid data. No information about the initiation of work on EN or PN draft standards

ISO **19131**:2007 *Data product specifications*

PN-EN ISO 19131:2008 (English)

Standard – provides requirements for the specification of geographic data products. It determines the structure and scope of the specification, and provides an example of applying the guidelines for the description of data product. The document provides detailed technical description of data set series, complemented by information on the creation, distribution and use of the product by other parties. Product specification defines a set of data in terms of requirements that the set should or could comply with

ISO **19132**:2007 *Location-based services – Reference model*

PN-EN ISO 19132:2008 (English)

Standard – model and a conceptual framework for location-based services (LBS), and describes the basic principles by which LBS applications may inter-operate. The document specifies the framework's relationship to other frameworks, applications and services for geographic information and to client applications

ISO **19133**:2005 *Location-based services – Tracking and navigation*

PN-EN ISO 19133:2007 (English)

Standard – describes the data types, and operations associated with those types, for the implementation of tracking and navigation services. This standard is designed to specify web services that can be made available to wireless devices through web-resident proxy applications, but is not restricted to that environment

ISO **19134**:2007 *Location-based services – Multimodal routing and navigation*

PN-EN ISO 19134:2008

Standard – specifies the data types and their associated operations to support the tracking and navigation applications for mobile clients, who want to get to their destination using two or more modes of transport. It describes the type of services, which support tracking and navigation, based on means of transport with strictly fixed route or timetable. The service may be made available to wireless devices through web-resident proxy applications. Services may also be implemented in other environments. The standard defines for each operation a pair – request/response and also specifies data types for the transfer, planning and information about the route of mean of transport

(continued)

Table 2.1 (continued)

ISO **19135**:2005 *Geographic information – Procedures for item registration*

PN-EN ISO 19135:2010 (Polish)

Standard – specifies procedures to be followed in establishing, maintaining and publishing registers of unique, unambiguous and permanent identifiers, and meanings that are assigned to items of geographic information. To achieve this goal the document specifies the details of information that is necessary to ensure the identification and meanings of the registered items and to manage the registration of these items

ISO **19136**:2007 *Geography Markup Language – GML*

PN-EN ISO 19136:2009 (English)

Standard – defines the geographic markup language (GML) to introduce XML-based standard for the spatial and non-spatial properties of geographic features. GML language determines the XML Schema syntax, mechanisms and rules that form the basis for system-independent description of the geospatial application schemas. XML encoding set in GML is compliant with ISO 19118 guidelines for transportation and storage of geographic information modelled in accordance with the guidelines of the conceptual model used in the family of International Standards ISO 19100

ISO **19137**:2007 *Core profiles of the spatial schema*

PN-EN ISO 19137:2008 (English)

Standard – defines a baseline profile for ISO 19107, which defines a minimal set of geometric elements needed to create geographic application schemas. Profile supports data types for zero-one-and two-dimensional simple geometric elements. A profile can be expanded in the future with a package of simple topological elements. Profile supports many of the spatial data formats and description languages already developed and in broad use within several nations or liaison organisations. Appendix A lists some specifications based on this profile. User groups can define their own profiles meeting specific requirements beyond the baseline profile. The rules for creating extensions of core profile are discussed in Appendix C

ISO/TS **19138**:2006 *Data quality measures*

No EN or PN standards

Technical specification – defines a set of data quality measures. These can be used when reporting data quality

ISO/TS **19139**:2007 *Metadata – XML schema implementation*

CEN ISO TS 19139:2009 Metadata – XML schema implementation

ISO/TS 19139:2007 defines Geographic MetaData XML (gmd) encoding

ISO 19140

No EN or PN standards

The project is not implemented.

ISO **19141**:2008 *Schema for moving features*

PN-EN ISO 19141

Standard – defines a method to describe the geometry of a feature that moves as a rigid body. The movement has defined characteristics. The feature moves within any domain composed of spatial objects as specified in ISO 19107, following the planned route, but it may deviate from the planned route. Movement may be affected by: fields (e.g. gravitational field), inertial forces as well as by other features. Motion of a feature can also affect other features. Moving feature follows a predefined route, part of a network, and might change routes at known points. Moving features may also attract each other (may be linked) or may be pushed apart (separate), and may also be constrained to maintain a given spatial relationship for some period. Other types of change to the feature, such as deformation, succession, change of non-spatial attributes, have not been addressed. Date of publication of EN norm: August 2009. PN standard is under development – planned completion date: December 2010

(continued)

Table 2.1 (continued)

ISO/DIS **19142**	*Web Feature Service*
prPN-EN ISO 19141	
Draft standard – defines web service for access and modification of the geographic features residing in a data store on a remote server. The service also provides means for the construction, storage and confiquration of queries to the server. Control of access to geographic features is not addressed in the document. PN standard is under development – planned completion date: December 2011	
ISO/DIS **19143**	*Filter encoding*
No EN or PN standards	
The draft standard.	
ISO/FDIS **19144-1**: 2009	
No EN or PN standards	
Final draft.	
ISO/CD **19144-2**	*Classification Systems – Part 2*: *Land cover classification system* (*LCCS*)
No EN or PN standards	
The draft standard.	
ISO/CD **19145**	*Registry of representations of geographic point location*
No EN or PN standards	
The draft standard.	
ISO/DIS **19146**	*Cross-domain vocabularies*
prPN-prEN ISO 19146	
The draft standard – defines the relationship between technical dictionaries, adopted by the various industry-specific geospatial communities. It also specifies an implementation of ISO 19135 for the registration of geographic information concepts for the purpose of integrating multiple domain-based vocabularies. PN standard is under development – planned completion date: December 2011	
ISO 19147	
No EN or PN standards	
The project is not implemented.	
ISO/CD **19148**	*Location-based services – Linear referencing system*
prEN ISO 19148	
Draft standard.	
Working on a draft EN standard is under way – planned completion date: October 2010	
ISO/CD **19149**	*Rights expression language for geographic information – GeoREL*
No EN or PN standard	
The draft standard.	
ISO 19150	
No EN or PN standard	
The project is not implemented.	
ISO/NP **19151**/CD	*Dynamic position identification scheme for ubiquitous space* (*u-position*)
No EN or PN standards	
Draft standard.	
ISO/CD **19152**	*Land Administration Domain Model – LADM*
prEN ISO 19152	
Work on draft EN standard is under way – planned completion date: December 2011	

(continued)

Table 2.1 (continued)

	Geospatial Digital Rights Management Reference Model (*RM GeoDRM*)
ISO/CD **19153**	
No EN or PN standards	
Draft standard	
ISO 19154	
No EN or PN standards	
The project is not implemented	
ISO/CD **19155**	*Place Identifier* (*PI*) *Architecture*
No EN or PN standards	
Draft standard	
ISO/CD **19156**	*Observations and measurements*
No EN or PN standard	
Draft standard	
ISO/NP **19157**	*Data quality*
prEN ISO 19157	
Work on EN standard is under way – planned completion date: February 2012	
ISO/NP TS **19158**	*Quality assurance of supply data*
No EN or PN standards	
Draft technical specification	
19159	*Calibration and validation of remote sensing imagery sensors and data*
ISO/NP TS 19159	

Approved and published ISO 19100 series standards are submitted to the Technical Committee CEN/TC 287 and after appropriate formal and legal procedures they are adopted as European norms EN ISO.

In accordance with the requirements of the European Union, approved European standards shall be adopted as national standards. In Poland, the Technical Committee PKN/KT 297 is responsible for this process with regard to geoinformation. This committee is the recipient of new European standards EN ISO, which, after formal and legal procedures are adopted and published as the Polish Norm PN-EN ISO. Unfortunately, for procedural reasons the adoption of ISO standards as European standards, and then as Polish norms is relatively long and may take several years. Currently (as of end of April 2010) 30 Polish norms PN-EN ISO are already adopted, and more, gradually, pass through the approval procedure.

This work also includes translations of standards from original version into Polish (see Table 2.1).

Explanations to the table:

Number of ISO standard	*Title of ISO standard*
Number of PN or EN standard	In case of PN standards, the language in which PN was published
Abstract and comments.	
Abstracts describing standards and projects were elaborated on the basis of information from the websites: http://www.iso.org; http://www.cen.eu; http://www.pkn.org.pl	

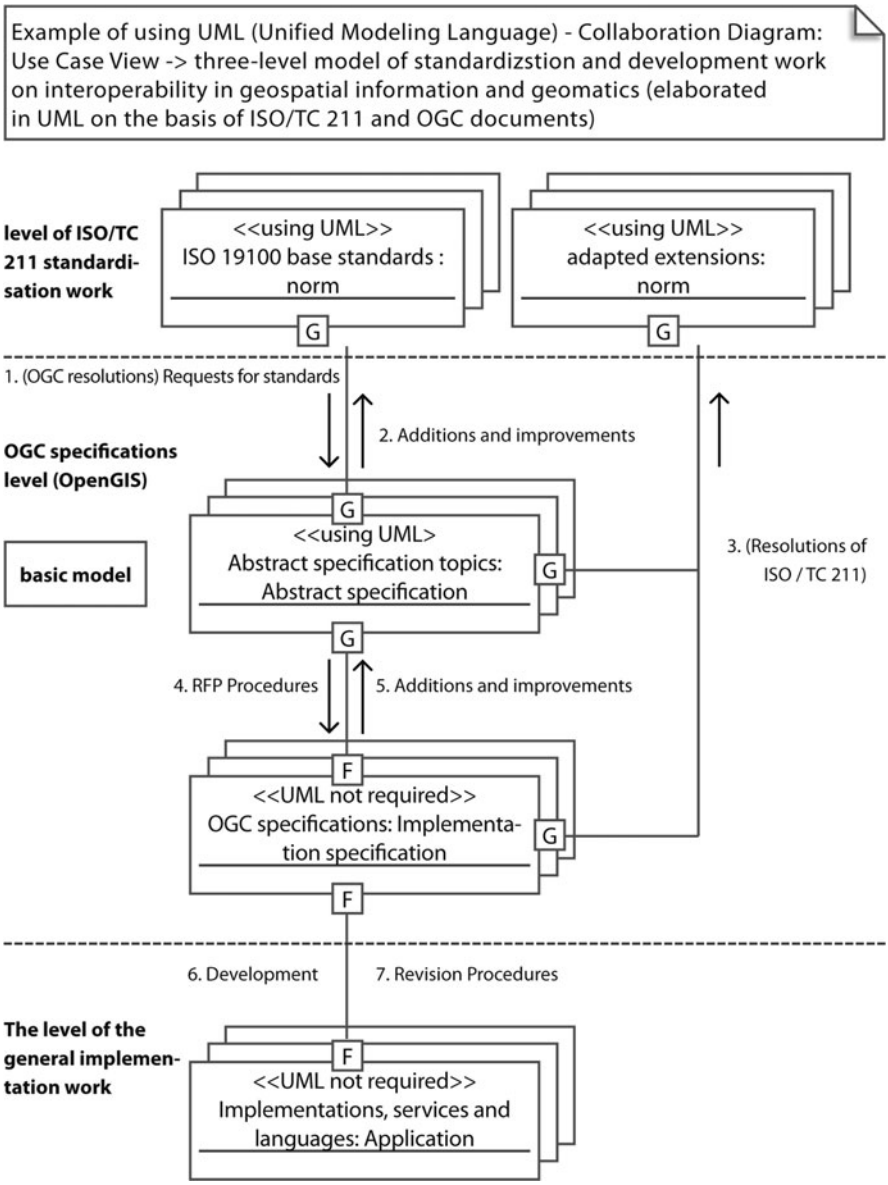

Fig. 2.1 Three-level model of standardisation and development work on interoperability in geospatial information and geomatics (elaborated in UML on the basis of ISO/TC 211 and OGC documents) (Michalak 2002)

Additional information about the Polish Standards can be found on PKN/TC 297 web portal, including an electronic version of the terminology guide (e-Guide) to the Polish Standards in the field of geographical information (http://e-przewodnik.

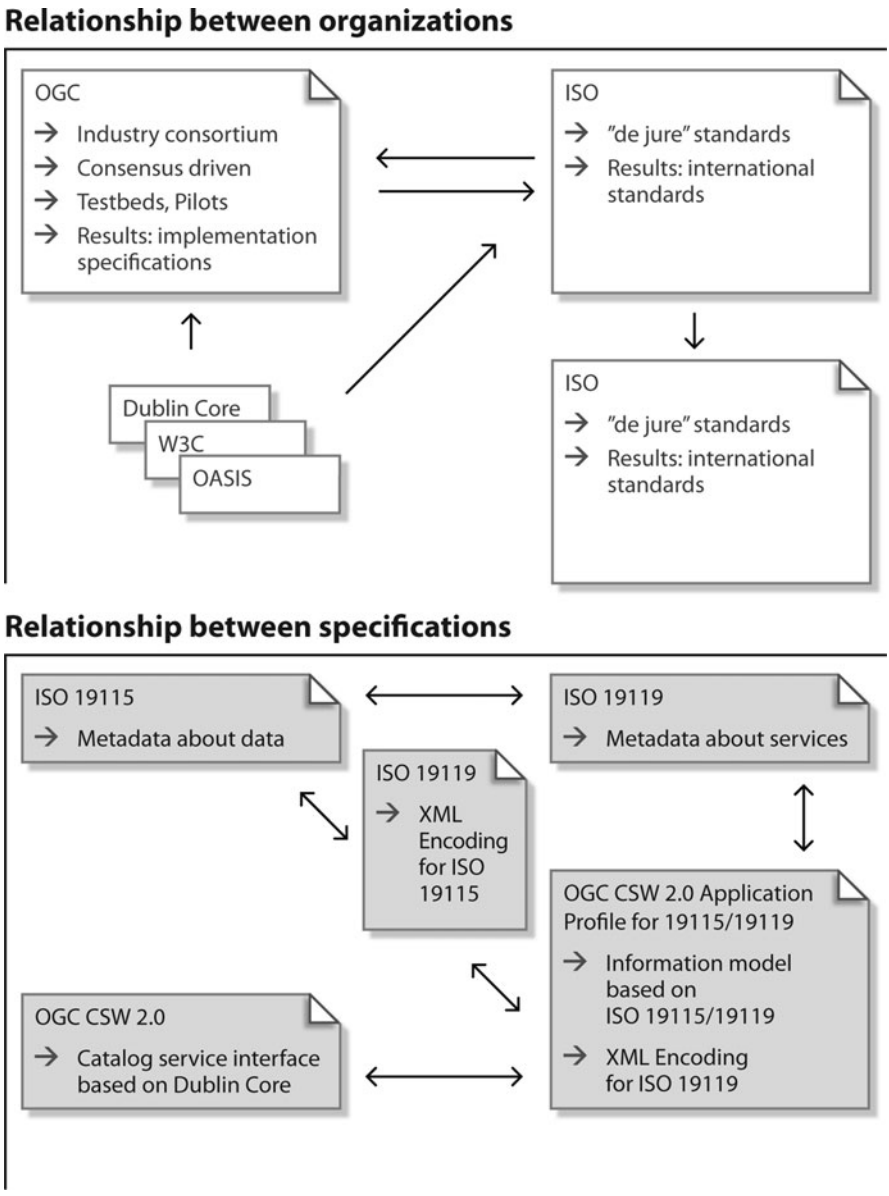

Fig. 2.2 Process of developing and approving geoinformation standards (Senkler 2006 – completed)

gugik.gov.pl) . During the preparation of this book, version 2.0 of the e-Guide of 13 December 2007 was available, relating to the 21 standards for ISO.

The process of development and validation of geoinformation standards described above is presented in the following diagram (Fig. 2.2).

CEN/ISO | ISO 191xx standards | OpenGIS specifications | PN norms

Initially, European standards were adopted as Polish standards by two methods: the recognition method and so-called cover-sheet method. Introduced by these methods, norms include the full text of the European standards in their original language, i.e. in English. Standards introduced by the cover-sheet method are equipped with title page in Polish language and with additional information in Polish, such as the preface and attachments. Cover-sheet method of introducing standards is no longer used (http://www.pkn.pl).

Currently, 28 of ISO 19 100 series standards adopted as European standards is also approved as Polish standards, of which only one (adopted in 2010 PN-EN ISO 19113:2009 Geographic information – Basic description of the quality) is published in Polish. Other standards are published in the original language, i.e. in English (http://www.pkn.pl). According to the information on PKN/KT 297 website (http://www.gugik.gov.pl/ tk297), translation into Polish was prepared only for one of 27 Polish Norms PKN/TC 297 (PN-EN ISO 19115:2005 metadata).

When discussing the Polish standards on geoinformation, it is important to comment on their formal, legal status and obligations and the possibility of their use, resulting from the current legal situation. The comments given below are based on the comment 17 (61/07) provided in the website of the National Land Information System Users Association (GISPOL) (http://www.gispol.org).

The application of standards is voluntary. Standards organisations are non-governmental organisations and as such may not impose or enforce the use of standards. It is the authority of the organisation, establishing standards by consensus as well as understanding of the influence of standardisation on economy that induces governments to adopt Polish, international or European standard for compulsory application.

The possibility of compulsory application of the standards was clearly stated in the previous laws on standardisation: Acts of 1961 and 1993. In the current Act of 2002, it results from Article 5 paragraph 4, in the context of the wording of the PN-EN 45020:2000. Under those provisions, although the application of Polish Standards is voluntary, those standards may be referenced by the legislation after their publication in Polish. The PN-EN 45020:2000 distinguishes normative references and recommendations, and introduces the term of mandatory standard – defined as the standard, which is mandated under the general law or through a reference in a provision of law requiring its use.

This means, that standards for spatial information that are currently published in English, may not be referenced by the legal regulations, until they are published in Polish. It is as if those standards did not exist. This issue is important as the regulation on the minimum requirements for computer systems to the Act on the Computerisation, refers (implicitly) to the discussed here Polish standards for geoinformation.

In this situation, it seems necessary to take immediate steps to develop and publish official versions of Polish Norms for geoinformation in Polish.

OGC Specifications or ISO 19100

In order to clarify issues related to the ISO 19100 series of standards and OGC specifications, we should answer three frequently asked questions about geoinformation standards (Michalak 2002a, b):

1. What are the main concerns of OpenGIS specifications and ISO 19100 standards?

Their main concern is interoperability of geoinformation systems, which are the building blocks of spatial information infrastructures. Therefore, these specifications regard elements needed to accomplish interoperability, that is:

- Unified data models
- Well defined interfaces
- Languages to access and manipulate data based on these interfaces
- Automatic translation of data and models

2. What aspects are not the concern of OpenGIS specifications and ISO 19100 standards?

These specifications do not concern the thematic aspect (regarding specific sectors) of geoinformation e.g. they define geometric types such as point, line or polygon, but not water gauge station, river or lake. Those aspects belong to particular thematic domains for example hydrology. Issues of web applications are also beyond the scope of these specifications, except issues regarding application layer (top layer in seven-layer OSI Network model or five-layer model of Internet).

Furthermore, within the mentioned application layer, specifications do not concern access rights to specific data sets in databases and processing systems or protection against unauthorised access. Also, they do not concern the system of charging for the accessed data.

If a geoinformation systems require to take into account the above mentioned features, the implementation of these feature is based on general IT standards regarding those issues. In such a case, system architecture is based on the collection of standards, including geoinformation standards.

3. What documents are better: ISO 19100 series standards or OGC specifications?

When a few years ago both these organisations began their operations separately, one could have an impression that the results of their actions would be different – even competing. Currently, however, co-operation is so far advanced that the results of the standardisation in this area are the joint work of both organisations – a significant part of ISO 19100 standards are adaptations of OGC specifications. The main difference between the two standards lies in the fact that the OGC specifications are technical documents, whereas ISO standards are formal, normative specifications.

Geoinformation standards represent a kind of summary of the current state of knowledge in geomatics and can be considered as a basis for further research on

these issues. However, due to the nature of the standardisation work of the technical committee ISO/TC 211, standards developed by this committee do not cover all aspects of this field. Still, they provide a framework, to which all other work on standardisation may relate, including purely research projects (Michalak 2002).

Quite a substantial difference between the ISO and OGC specifications is payment for standards. OGC specifications are free of charge and can be downloaded for free from the website of the Consortium. In contrast, standards issued by ISO, CEN and PKN must be purchased. Information about current rates, and forms and methods of purchase is available on the websites of ISO, CEN and PKN.

ISO 19100 Series of Standards

ISO geoinformation standards are formalised specifications and therefore differ significantly from the typical criterion standards. Another thing that sets them apart is the use of UML diagrams (Unified Modelling Language – a formal language used to describe the world of objects in object-oriented analysis and object-oriented programming), describing in detailed and precise way the conceptual models presented there (Fig. 2.3).

Therefore, to use these standards fully and efficiently some knowledge of UML is needed, at least ability to read and understand class diagrams. To better present this issue, graphic notation for above mentioned conceptual models is presented, which may be helpful in reading and analysing them (Fig. 2.4).

The table below, which summarises issues dealt with by ISO 19100 standards series (Table 2.1) allows to become familiar with their scope and subject matter, as well as with the timetable of ISO/TC 211 committee work (after Michalak 2002 – revised and supplemented).

The discussed standards, although consist of separate documents, are closely interrelated and complementary. The relationships between ISO standards are presented in Fig. 2.5.

OGC Specifications

The specifications developed by the OGC are divided into two levels in terms of generality. Some of these specifications were submitted to the Technical Committee ISO/TC 211 and after completion of formal procedures they were adopted as ISO 19100 series standards. Higher level, called the *Abstract Specification* is independent of the system environment. On the lower level are ***Implementation Standards*** – equivalent to the specification at a higher level but adapted to different implementation environments. This level also includes other OGC implementation documents, which do not correspond to Abstract Specification

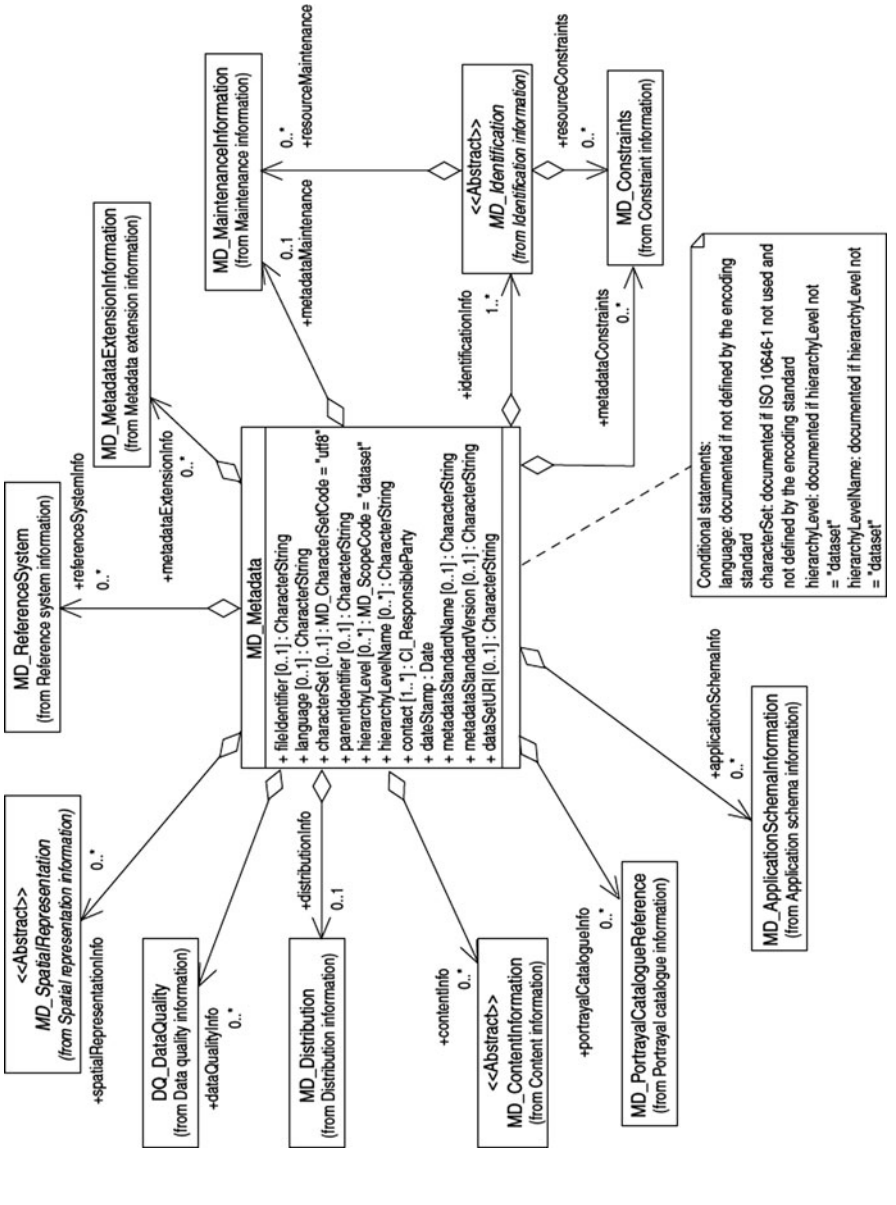

Fig. 2.3 Information about a set of metadata entities – example of UML conceptual model of ISO 19115

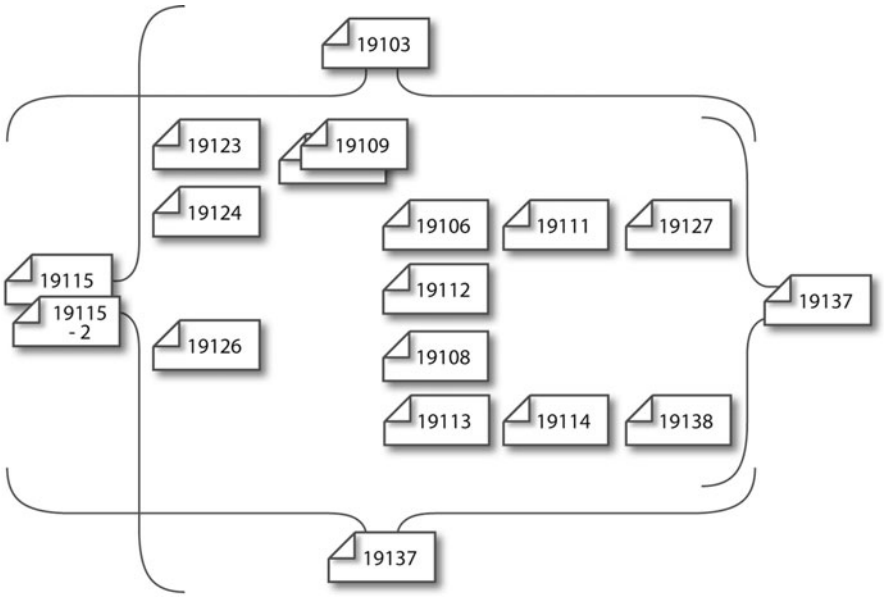

Fig. 2.4 Relationships and dependencies between selected ISO 19100 series standards

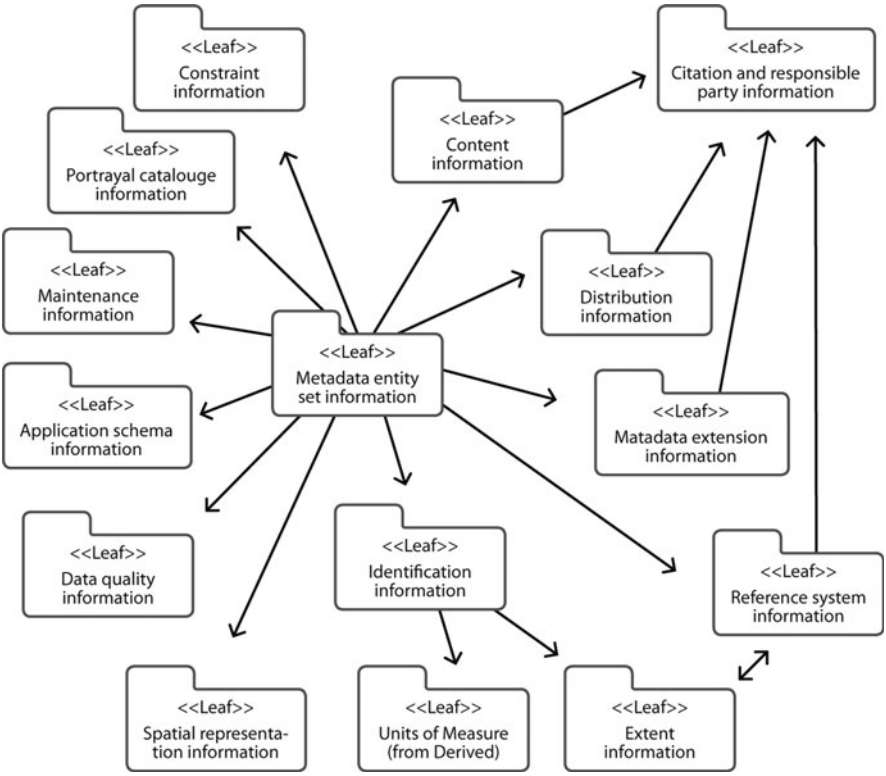

Fig. 2.5 Metadata packages according to ISO 19115

Table 2.2 OpenGIS Specifications (OGC)

Document title	Version	Document	Date of revision
Topic 0 – **Abstract Specification Overview**	5.0	04-084	27.06.25
Presents general principles regarding the entire OpenGIS Specification, defines UML as primary description tool and lays down rules for its use in Abstract Specification. Includes an introduction and a roadmap for the OpenGIS Specification			
Topic 1 – **Feature Geometry**	5.0	01-101	10.05.2001
Defines elementary and complex geometric and topological forms and topological operators used for features.			
Equivalent to ISO 19107 standard			
Topic 2 – **Spatial Reference Systems**	3.0	04-046r3	11.02.2004
Addresses all issues regarding direct geospatial references			
Theme 3 – **Locational Geometry Structures**	4.0	99-103	18.03.1999
Defines structures, which determine the relationship between the conversion of one reference system into another, and mapping corresponding co-ordinate values			
Theme 4 – **Stored Functions and Interpolation**	4.0	99-104	30.03.1999
Specifies the rules for functions being the components of features related to the object-oriented paradigm derived from the UML language			
Topic 5 – **Features**	5.0	08-126	15.01.2009
Defines the most important concept in the field of spatial information: "feature is the primary (elementary) unit of a geoinformation" and a number of specific, related issues			
Topic 6 – **The Coverage Type and its Subtypes**	7.0	07-011	28.12.2007
Defines coverage as subtype of a feature, its conceptual model and a number of coverage subtypes			
Topic 7 – **The Earth Imagery Case**	5.0	04-107	15.10.2004
Defines the images of the Earth (e.g., aerial photographs and satellite images) as a special sub-type of coverage with the method of transition from picture element to the corresponding co-ordinates of a particular reference system. Corresponds to the ISO 19101-2			
Topic 8 – **Relationships Between Features**	4.0	99-108r2	26.03.1999
Defines types of relationships, roles of individual features in these types of relationships, and types of roles			
Topic 10 – **Feature Collections**	4.0	99-110	07.04.1999
Defines feature collection as an abstract object that contains feature instances, including related schema			
Topic 11 – **Metadata**	5.0	01-111	08.06.2001
Defines metadata as data relating to the feature collection or to specific features which are elements of such collection. Introduces the concept of metadata entity and metadata set which is a collection of metadata entities, as well as the concept of metadata subclasses			
Topic 12 – **OpenGIS Service Architecture**	4.3	02-112	14.09.2001
Basic services, which may be used in a system environment consistent with OpenGIS Specification. Equivalent to ISO 19119			
Topic 13 – **Catalogue Services**	4.0	99-113	31.03.1999
This is an extension to geospatial information access services, providing more detail on the related services by defining the Catalogue, Catalogue Entry, librarian and metadata entities in the catalogue			
Topic 14 – **Semantics and Information Communities**	4.0	99-114	04.04.1999
In the context of OpenGIS Specifications the notion of information communities usually means professional groups using geoinformation and exchanging this kind of information			
Topic 15 – **Image Exploitation Services**	6.0	000-115	24.04.2000

(continued)

Table 2.2 (continued)

Document title	Version	Document	Date of revision
These services include ground co-ordinate transformation, image co-ordinate transformation, imaging time determination, and image modification and transformation services			
Topic 16 – **Image Co-ordinate Transformation Services**	4.0	00-116	24.04.2000
Covers all aspects of spatial and temporal transformations of images, including orthorectification of these images			
Topic 17 – Location Based Mobile Services	0.0	00-117	15.05.2000
Draft specification regarding positioning services. Never formally adopted			
Topic 18 – Geospatial Digital Rights Management Reference Model (GeoDRM RM)	1.0.0	06-004	29.01.2007
This document is a reference model for digital rights management (DRM) functionality for geospatial resources (GeoDRM)			

Prepared on the basis of the information available on the website: http://www.opengeospatial.org/ and in J. Michalak elaboration (2003)

(Michalak 2003; OGC). The overall scope of issues addressed by OGC Abstract Specification is defined by 19 topics (parts). An important part of the OGC studies form OGC Implementation Standards and related documents. Implementation Standards currently regard 28 topic categories (as of end of February 2009).

Table below presents issues dealt with in various OGC specifications (Table 2.2) along with their scope and subject matter (after Michalak 2002 – revised and supplemented).

Metadata Standards for Geoinformation

For the purposes of characterising metadata standards for geoinformation, they can be divided into two main groups. The first group includes standards that define rules for describing resources, i.e., for creating metadata. In the second group we can place standards for the dedicated metadata services – that is, standards for metadata catalogues. Since the individual standards do not fully exhaust particular subject matters, in many places they refer to other standards. For example, if the standard for metadata requires recording creation date, the proper way to record dates is regulated by a standard for temporal references. For this reason, discussed standards can also be divided into: main standards, directly regarding metadata, and additional standards – necessary for the proper establishment and/or functioning of the metadata, but regarding other matters.

The group of main standards for metadata includes primarily ISO 19115.

ISO 19115:2003 Geographic Information: Metadata

ISO 19115 standard was published in May 2003. This standard was developed as the result of broad international co-operation of representatives from 33 countries

and 12 organisations. In developing of the standard, rich experience gained in the development and use of previous standards for metadata: the European CEN pre-norm 12657 of 1998 and standard of FGDC (U.S. Federal Geographic Data Committee) of 1994, was taken into account the.

ISO 19115 standard defines the schema for the description of spatial data resources and related services. It is applied to cataloguing and fully describing the metadata. Rules included in this standard can be used to describe spatial data, spatial data series and individual objects and their attributes.

The standard defines sets of metadata to record information on: the identification of spatial data sets, their scope and coverage, data quality, applied spatial and temporal schemas, reference systems and mapping systems and the rules of distribution of spatial data in digital form (Fig. 2.5).

The standard defines the conceptual schema of the metadata in the form of UML class diagrams complemented by a tabular description. Mandatory, optional and conditional metadata elements were indicated and ISO Metadata Profile was defined. The document establishes a uniform terminology for metadata and provides mechanisms for extending the normative metadata with new elements in order to meet the specific information needs of users of the standard – metadata creators.

Although the standard was basically conceived to be used for digital data, it can also be used to describe (create metadata) for spatial information not in digital (electronic) form, e.g. for paper maps, charts and text documents and also for not spatial data resources. It should, however, be noted that some metadata elements, made by this standard obligatory, may not apply to other forms of data.

In 2005, the ISO 19115 standard was adopted as European standard EN ISO 19115:2005 Geographic information – Metadata and the Polish Norm PN-EN ISO19115: 2005 Geographic information – Metadata (version in English). This standard was also translated into Polish as early as 2004 but this version was not published and distributed.

In 2006, ISO/TC 211 committee published a corrigendum to this standard: ISO 19115:2003/Cor 1:2006. It was adopted by CEN in 2008 under the name "ISO 19115:2005/AC: 2008 Geographic information – Metadata (ISO 19115:2003/Cor 1:2006) and PKN as a PN-EN ISO 19115:2005/AC:2008 Geographic information – Metadata (version in English). Neither PKN website nor PKN/KT 297 committee website give any information on the translation of this corrigendum into Polish.

In early 2009, the ISO/TC 211 committee published an extension to this standard as ISO 19115–2:2009 Geographic information – Metadata – Part 2: Extensions for

imagery and grid data. It extends the existing standard, by providing the required schema for description (metadata) of aerial photographs, satellite imagery and grid data. This schema contains information about the parameters of measuring devices used for data acquisition, the geometry of the measuring process, data acquisition process and the production process – raw data digitisation. Currently there is no information about the approval of the extension by CEN/TC 287 or PKN/KT 297.

ISO 19115 is an international standard, its national counterpart in the U.S. is, already mentioned, FDGC metadata standard endorsed in 1998. It should be stressed that currently FDGC standard is being replaced by ISO 19115.

Please note that the first attempt to develop an international standard for the description of any digital resources (documents) through various types of metadata was DublinCore standard (as mentioned earlier, mainly used to describe library resources, but also used to describe digital spatial data resources). Currently DublinCore is being replaced with an ISO standard.

ISO/TS 19139:2007 Geographic Information: Metadata: XML Schema Implementation

Another major standard from the first group is ISO/TC 19139. It defines a way of encoding ISO metadata in XML notation through XML Schema Definition (XSD). Applying this standard is necessary, if the metadata are to be published in the metadata catalogues and properly function in the Internet, and thus within the Spatial Data Infrastructure (SDI).

ISO/TS 19139:2007 is in fact a technical specification, which defines encoding of metadata created according to ISO 19115 in XML notation. It specifies the only appropriate UML model for an interpretation of ISO 19115 abstract metadata model and defines the corresponding XML Schema (XSD) for the collection and transfer of meta-information. It was developed to provide a common XML specification for the description, verification and exchange of geoinformation metadata. It provides a formal structure for describing spatial information resources that can be managed by the catalogue services in accordance with the profile of the application.

Currently, standard (Technical Specifications) has already been adopted as European standard CEN ISO/TS 19139:2009 Geographic information – Metadata – XML schema implementation (ISO/TS 19139:2007). There is no information on the planned start of work on adopting it as the Polish Norm.

ISO 19119:2005 Geographic Information: Services

The most important standard from a group of standards for metadata catalogues is ISO 19119. It deals with all general spatial data services, including catalogues of metadata.

The standard identifies and defines the architecture patterns for service interfaces in the field of spatial information and determines their relationship to the Open-Source Software (FOSS) environment. Moreover, it presents a geographic service taxonomy and a list of example geographic services placed in the services taxonomy. It also contains guidelines for the selection and specification the spatial information services in terms of both platform-independent services, as well as platform-specific services.

In 2006, the ISO 19119 standard was adopted as European standard EN ISO 19119:2006 Geographic information – services and the Polish Norm PN-EN ISO 19119:2006 Geographic information – services (English version). Translation of this standard into Polish is under way. According to the schedule of PKN/KT 297, Polish language version of this standard is to be published in late December 2009.

In 2008, ISO/TC 211 committee published an amendment to this standard as ISO 19119:2005/Amd 1:2008 Extensions of the service metadata model. This amendment concerns the extension of the specification for metadata catalogue services. Currently there is no information about the approval of the extension by the CEN/TC 287 or PKN/KT 297.

The discussed group of standards should also include specifications: OGC CSW (*Catalogue Service for the Web*) 2.0 and OGC CSW Application Profile for 19115 and 19119.These standards relate to the capabilities of publishing and discovery of information describing spatial data sets and spatial data services. These standards define how metadata catalogues shall be constructed, how they shall operate, and based on which metadata profile (in this case ISO). It should be noted that OGC specifications for CSW (metadata catalogue) could also be applied to different (non-ISO) profile such as: FDGC, Dublin Core, ebRIM.

Relationships between the major standards for metadata are presented on the following diagram (Fig. 2.6):

Additional standards regarding metadata catalogues are the following OGC documents for services and metadata (Web Registry Service):

- OGC 99113, OGC Abstract Specification Topic 13: Catalogue Services
- OGC 02006, OGC Abstract Specification Topic 12: OpenGIS Service Architecture
- OGC 04021r3, OGC Catalogue Services Specification, v2.0.1 (with Corrigendum)
- OGC 04095, OGC Filter Encoding Implementation Specification, version 1.1.0
- OGC 05008, OGC Web Services Common Specification, version 1.0

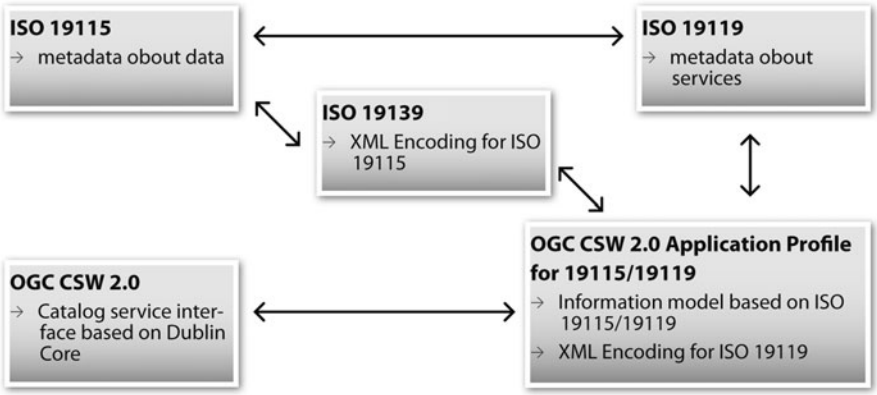

Fig. 2.6 Diagram of relationships between standards for geospatial metadata (Senkler 2006, 2007)

ISO 19135:2005 Geographic Information: Procedures for Item Registration

Another standard – that can be included in a group of additional standards – which is very important, because of the need to develop appropriate identifiers for metadata files and metadata managing systems, is ISO 19135:2005 standard (Senkler 2006, 2007).

The standard defines the procedures to be followed during the establishment, maintenance and publication of registers of unique, unambiguous and permanent identifiers and meanings assigned to spatial information registry entries. To achieve this objective the standard specifies the elements of information that are necessary to ensure the identification and meaning to the registered items, and to manage the registration of these items.

In 2007, ISO 19135 was adopted as European standard EN ISO 19135:2007 Geographic information – Procedures for item registration and the Polish Norm PN-EN ISO 19135:2007 Geographic information – Procedures for registration of items registered (English version). Translation of the standard into Polish is under way. According to the PKN/KT 297 roadmap, Polish language version of this standard is to be published in late December 2009.

Other additional standards indirectly relevant to the metadata, are following ISO standards (Kubik 2007):

- ISO 19105:2000 Conformance and Testing
- ISO 19106:2004 Profiles
- ISO 19108:2002 Temporal schema

- ISO 19125-1:2004 Simple feature access – Part 1: Common architecture
- ISO 19125-2: Simple feature access – Part 2: SQL option
- ISO/CD 19136:2007 Geography Markup Language (GML)
- ISO 639:2002 Codes for the representation of names of languages
- ISO 8601:2004 Representation of dates and times

W3C recommendations relevant to metadata catalogues – W3C documents on the XML applications (Kubik 2007):

- W3C Recommendation January 1999, Namespaces in XML
- W3C Recommendation 6 October 2000, Extensible Markup Language (XML) 1.0 (Second Edition)
- W3C Recommendation 2 May 2001: XML Schema Part 0: Primer
- W3C Recommendation 2 May 2001: XML Schema Part 1: Structures
- W3C Recommendation 2 May 2001: XML Schema Part 2: Datatypes
- W3C Recommendation (24 June 2003): SOAP Version 1.2 Part 1: Messaging Framework
- WSDL, Web Services Description Language (WSDL) 1.1

Metadata are available through metadata catalogue services, which are Internet services – web services. Therefore, it is important that these sites also meet the following standards regarding the HTTP protocol (Kubik 2007):

- IET F RFC 2388, Returning Values from forms: multipart/formdata
- IET F RFC 2616, Hypertext Transfer Protocol HTTP/1.1

While discussing standards for metadata, one should also mention the current trends and developments in the field of standardisation. In January 2007 it was officially announced that the OGC has adopted a new standard for online catalogues of metadata – based on the ebRIM profile (e-registry information model of business) by OASIS organisation. The current version is: OASIS ebRIM, ebXML Registry Information Model Version 3.0. In future ebRIM profile is to become the preferred profile for the OGC metadata catalogues for the CSW specification (*Catalogue Service for Web*). This standard was chosen because of its versatility and flexibility – it allows for cataloguing and managing of services, various types of information and records such as library catalogues, co-ordination systems, application profiles and schemas, as well as spatial data and related services. This standard does not preclude the existing methods and search services provided by the previously used protocols.

http://www.springer.com/978-3-642-15861-2

Geoinformation Metadata in INSPIRE and SDI
Understanding. Editing. Publishing
Litwin, L.; Rossa, M.
2011, XII, 168 p., Hardcover
ISBN: 978-3-642-15861-2