

Global geomatics standards supporting sustainable geospatial data infrastructures

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Abstract

The goal of international standardization in the field of geographic information is to develop a family of standards that will:

- support the understanding and usage of geographic information
- increase the availability, access, integration, and sharing of geographic information, enable interoperability of geospatially enabled computer systems
- and ease the establishment of geospatial infrastructures on local, regional and global level.

and thus contribute to a unified approach to addressing global ecological and humanitarian problems and a sustainable geospatial data infrastructure!

The paper will describe the status of the work programme, the participants in developing the standards – both national members and liaison organizations, and the successful cooperation with the industry through Open GIS Consortium.

Introduction

The work programme of ISO, the International Organization for Standardization, is to develop global standards. Within the field of geographic information and geomatics, ISO/TC 211 is the committee charged with this task. ISO/TC 211 is currently developing a work programme of more than 30 items, most of them will become international standards within few months. The committee is in the final phase of its first large enterprise of laying the standards fundament for the field of geomatics. This foundation has already proved to be essential to the building of sustainable geospatial data infrastructures, both at the national, regional and global level.

The ISO/TC 211 work programme has attracted a high degree of attention. Many important bodies have committed themselves to the evolving international standards of the committee, including GSDI in the SDI cookbook, for instance. Through its work in the fields of terminology, conceptual modeling including models for geometry, topology, temporal aspects and general feature modeling, spatial referencing, quality, metadata, positioning, portrayal, encoding, service architecture, etc., the ISO/TC 211 programme develops a whole foundation upon which all technical aspects of the geospatial infrastructure can be built.

Spatial Data Infrastructure

In the “The SDI Cookbook” we find the following definition:

The term “Spatial Data Infrastructure” (SDI) is often used to denote the relevant base collection of technologies, policies and institutional arrangements that facilitate the availability of and access to spatial data. The SDI provides a basis for spatial data discovery, evaluation, and application for users and providers within all levels of government, the commercial sector, the non-profit sector, academia and by citizens in general.

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An SDI must be more than a single data set or database; *an SDI includes geographic data and attributes, sufficient documentation (metadata), a means to discover, visualize, and evaluate the data (catalogues and Web mapping), and some method to provide access to the geographic data. Beyond this are additional services or software to support applications of the data. To make an SDI functional, it must also include the organizational agreements needed to coordinate and administer it on a local, regional, national, and or trans-national scale.*

Thus we see that several requirements must be fulfilled before we can talk about an SDI. E.g. data is not enough – neither as a single dataset or a database, nor as a set of datasets or databases. Without the possibility to discover data and evaluate data through some mechanism like a metadata catalogue, and ways of accessing data through Internet (e.g. web), it is no *spatial data infrastructure*. It is in these respects that so many still fails to fulfill the requirements. Data may exist – even high quality and large scale data – but it is very difficult for the public to obtain access. Both technology, authorization and pricing may constitute – together, or each – insurmountable obstacles. Concerning technology, the notion of interoperability is a key concern.

Interoperability is the ability of a system or system component to provide information sharing and inter-application co-operative process control. Standardization of geographic information can best be served by a set of standards that integrates a detailed description of geographic information concepts with the concepts of information technology. A goal of the ISO 19100 series standardization effort is to facilitate interoperability of geographic information systems, including interoperability in distributed computing environments. Interoperability provides the freedom to mix and match information system components without compromising overall success. Interoperability refers to the ability to:

- a) Find information and processing tools, when they are needed, independent of physical location.
- b) Understand and employ the discovered information and tools, no matter what platform supports them, whether local or remote.
- c) Evolve a processing environment for commercial use without being constrained to a single vendor's offerings.
- d) Build upon the information and processing infrastructures of others in order to serve niche markets, without fear of being stranded when the supporting infrastructure matures and evolves.
- e) Participate in a healthy marketplace, where goods and services are responsive to the needs of consumers and where commodity channels are opened as the market expands sufficiently to support them.

Although not explicitly stated, it is clear that *standards* is a fundamental requirement in both obtaining interoperability and, more general, to build the SDI.

Standardization

Standards are documented agreements containing technical specifications or other precise criteria to be used consistently as rules, guidelines, or definitions of characteristics, to ensure that materials, products, processes and services are fit for their purpose. The existence of non-harmonized standards for similar technologies in different countries or regions can contribute to so-called "technical barriers to trade". Export-minded industries have long sensed the need to agree on world standards to

help rationalize the international trading process. This was the origin of the establishment of ISO.

Work in the fields of environmental management and geographic information are among the newer activities, taken up in the mid 1990's.

International standardization is well-established for many technologies in such diverse fields as information processing and communications, textiles, packaging, distribution of goods, energy production and utilization, shipbuilding, banking and financial services. It will continue to grow in importance for all sectors of industrial activity for the foreseeable future.

Development agencies are increasingly recognizing that a standardization infrastructure is a basic condition for the success of economic policies aimed at achieving sustainable development. Creating such an infrastructure in developing countries is essential for improving productivity, market competitiveness, and export capability.

Geographic information market and standards

All businesses that produce, distribute, or utilize spatial information alone or in conjunction with non-spatial information will benefit from spatial standards. Environments supported include geographic information, decision support, data mining, data warehousing and modeling and simulation. Application areas include but are not limited to automated mapping, geo-engineering, computer aided drafting and design, entertainment, modeling, and simulation. These span the planning, design, construction, operation, and maintenance of facilities and their supporting infrastructure such as communications, transportation, and utilities.

A common way to describe the market is by dividing it into three segments: the traditional geographic information systems (GIS) market, business support systems (BSS), and personal productivity (PP). A description can be given as:

- GIS:
 - Spatial information contributes the most value
 - Traditional market for spatial technology
- BSS:
 - Spatial information does **not** contribute the most value
 - Spatial technology embedded in business applications
- PP:
 - Users want to communicate with maps/ geographic information
 - Follows Office Suite marketA new emerging market is location-based mobile services (LBMS).

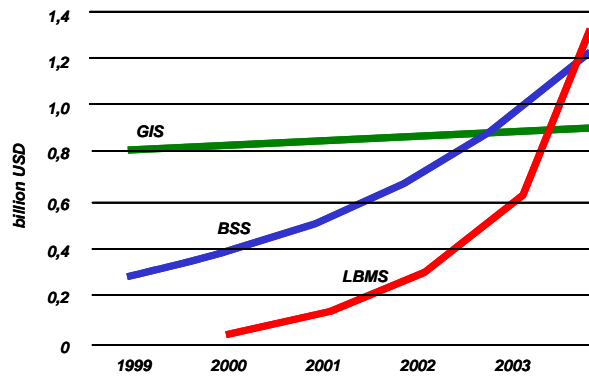


Fig. Revenues in the traditional GIS market (GIS), for business support systems (BSS) and the emerging technology, location based mobile services (LBMS) according to IDC.

There are many places in the marketplace that will benefit significantly from interoperable access to spatial information and services. Industry sectors include such areas as the travel and tourism industries, the mapping and routing industries, communications, utilities, transportation, national defense, agriculture, disaster management and public safety, location/mobile services, inventory management, real and synthetic environmental modeling and gaming, and the emerging needs of electronic commerce for spatial information.

Achieving more interoperability requires proactive coordination of spatial standards at both the abstract and implementation levels of detail. Proactive cooperation between spatial standards activities should also help to utilize, more efficiently, available resources by minimizing technical overlap, where appropriate. Such coordination and cooperation should lead to more market relevant spatial standards and could serve as a useful roadmap for all interested parties.

The increasing recognition for the value of spatial data and geographic information has spawned the entry of new players into the spatial standardization arena, both from within ISO and externally. This has resulted in the formation of a Joint Steering Group on Spatial Standardization and Related Interoperability, chaired by the ISO/TC 211 Chairman. Consequently, a new agenda is emerging for international spatial standardization that includes traditional and new innovative applications across a spectrum of disciplines. For ISO/TC 211, these developments are resulting in new strategic directions.

Current members :

ISO Central Secretariat, ISO/TC 211, OGC, SEDRIS

The following organizations have also been invited and/or participated in the process:

DGIWG	OMG
IETF	POSC
ISO/TC 184 /SC 4	SAE International
ISO/TC 204	SISO
ISO/IEC JTC 1	W3C
ISO/IEC JTC 1/SC 24	WAP forum
ISO/IEC JTC 1/SC 31	
ISO/IEC JTC 1/SC 32	

Scope of the ISO/TC 211

Beyond the needs within traditional applications of digital geographic information, there is a growing recognition among users of information technology that indexing by location is a fundamental way to organize and to use digital data. Increasingly, digital data from a wide variety of sources is being referenced to locations for use in a diversity of applications. Consequently, there is an increasing need for standardization of geographic information and services for processing this information. To meet this need, the ISO 19100 series (i.e. the standards developed by ISO/TC 211) standardizes relevant aspects of the description and management of geographic information and geographic information services. This standardization will:

- a) increase the understanding and usage of geographic information;
- b) increase the availability, access, integration, and sharing of geographic information;
- c) promote the efficient, effective, and economic use of digital geographic information and associated hardware and software systems;
- d) contribute to a unified approach to addressing global ecological and humanitarian problems.

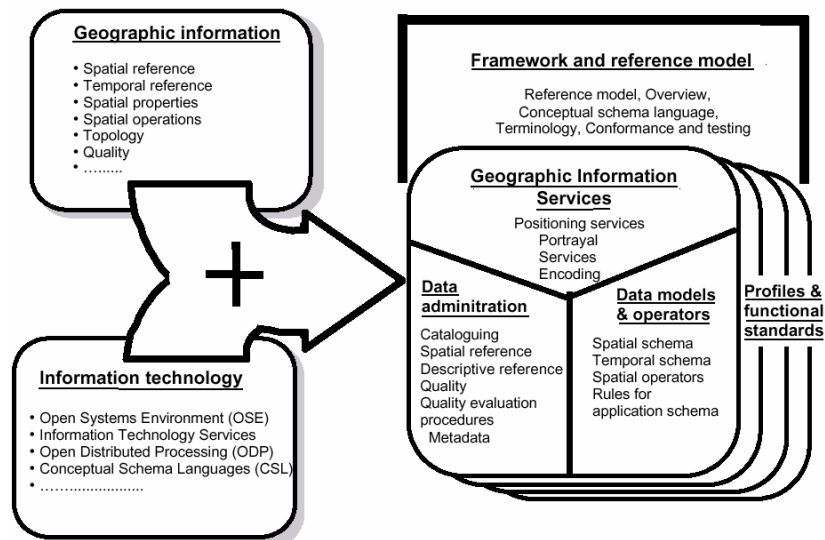


Fig. "Map" of the ISO/TC 211 approach to standardization

The ultimate benefits of standardization are based on the use of widely recognized and accepted international voluntary standards developed to the highest technical level by an open consensus process that includes all those affected. Beyond standardization of traditional geographic functionality: innovative, new, and unknown technology and application domains present challenges transcending the established process of geographic standardization. Previously, standardization was a process for recognizing and codifying the status quo of technology. Standardization is now beginning to define the requirements and implementation of new technology.

The implied mandate for ISO/TC 211 is to develop an integrated set of standards for geographic information. Equally important, if not more so, is the unstated strategic direction for the international deployment of such standards. Accordingly, the strategic directions for ISO/TC 211 can be viewed in terms of development, deployment, and the underlying coordination/consensus process that integrates both these phases for successful standardization.

Global geomatics standards supporting sustainable geospatial data infrastructures

For development, the major issues include: standards technical development, organizations developing geographic or related standards, priorities of standards, standards and interoperability testing, and speed of developing technical specifications. For deployment, the key issues are: implementation of standards, standards education / training, and user communities supporting ISO/TC 211 standards.

Inherent and pervasive through standards development, deployment, and their coordination/consensus process are considerations for the implementors and users of geographic standards. Such as data transfer standards that are implemented by vendors or data cataloguing standards implemented by data producers, or metadata standards implemented by vendors, data producers, and general users of geographic information. Implementors and user requirements need to be considered in conjunction with the standards development, deployment, the process of integrating such requirements.

Traditionally, geographic information was produced and used by the geographic community. Increasingly, geographic information is being created and used by everyone else, especially, in the business community. Hence, the once all important technical issues for experts are now being subordinated to the business issues confronting government and commercial organizations. Previously, the cost of standardization was minimal because of the number of users and requirements. Because geographic information has transitioned, in many countries, from being the essence of national mapping organizations to being the common commodity of consumers in the electronic/Internet/wireless communities – the diverse requirements, costs, and complexity for geographic standardization has increased dramatically.

ISO 19101 - Reference model	ISO 19117 - Portrayal
ISO 19102 - Overview	ISO 19118 - Encoding
ISO 19103 - Conceptual schema language	ISO 19119 - Services
ISO 19104 - Terminology	ISO/TR 19120 - Functional standards + new revision started
ISO 19105 - Conformance and testing	ISO/TR 19121 Imagery and gridded data
ISO 19106 - Profiles	ISO/TR 19122 - Qualifications and certification of personnel
ISO 19107 - Spatial schema	ISO 19123 - Schema for coverage geometry and functions
ISO 19108 - Temporal schema	ISO 19124 - Imagery and gridded data components
ISO 19109 - Rules for application schema	ISO 19125-1 - Simple feature access – Common architecture
ISO 19110 - Feature cataloguing methodology	ISO 19125-2 - SFA - SQL option
ISO 19111 - Spatial referencing by coordinates	ISO 19125-3 - SFA – COM/OLE
ISO 19112 - Spatial referencing by geographic identifiers	ISO 19126 - Profile - FACC Data Dictionary
ISO 19113 - Quality principles	ISO 19127 - Geodetic codes and parameters
ISO 19114 - Quality evaluation procedures	ISO 19128 – Web map server interface
ISO 19115 - Metadata	ISO 19129 - Imagery, gridded and coverage data framework
ISO 19116 - Positioning services	ISO 19130 - Sensor and data models for imagery and gridded data

Table. The current ISO/TC 211 work programme

ISO/TC 211 is currently accomplishing a very challenging task in developing – mostly in parallel – the set of standards as illustrated in the table above. The first standard is approved for publication and several more will be available during 2001.

References

The SDI Cookbook, version 1.0, GSDI, www.gsdi.org
International Organization for Standardization, www.iso.ch
ISO/TC 211 Geographic information/Geomatics, www.statkart.no/isotc211/
Joint Steering Group on Spatial Standardization and Related Interoperability, www.statkart.no/jsgspatial/