

Standards overview

Overview of standards concerning spatial data

There are many standards to consider when building a web based information system. Since a lot of the information included in the CSA is to be in form of maps (flood maps / contingency plans for different crisis scenarios), the standards regarding geospatial data would have to be studied.

Regarding geospatial data, three institutions have to be considered: The Open Geospatial Consortium, the EU and its Directive 2007/2/ES (INSPIRE) and the International Organisation for Standardization (ISO).

Open Geospatial Consortium (OGC)

Previously known as Open GIS Consortium, the OGC groups more than 400 companies, government agencies and universities, participating in a consensus process to develop publicly available interface standards, regarding geospatial datasets. The OGC developed many standards, but let us concentrate on those regarding web (internet) services, since the CSA system would work as a widely accessible internet service.

The OGC developed next web standards (<http://www.opengeospatial.org/standards>):

- WCS (Web Coverage Service), which defines a standard interface and operations that enable interoperable access to geospatial "coverages" (digital geospatial information representing space-varying phenomena), such as satellite images, digital aerial photos, digital elevation data, and other phenomena represented by values at each measurement point.
- WCPS (Web Coverage Processing Service), which defines a language for retrieval and processing of multi-dimensional geospatial coverages.
- WFS (Web Feature Services) allow clients to only retrieve or modify the data they are seeking (at the feature and feature property level), rather than retrieving a file that contains the data they are seeking and possibly much more. This International Standard specifies the behaviour of a service that provides transactions on and access to geographic features in a manner independent of the underlying data store. It specifies discovery operations, query operations, locking operations, transaction operations and operations to manage stored parameterized query expressions.
- WMS (Web Map Service) Interface Standard provides a simple HTTP interface for requesting geo-registered map images from one or more distributed geospatial databases. A WMS request defines the geographic layer(s) and area of interest to be processed. The response to the request is one or more geo-registered map images (returned as JPEG, PNG, etc) that can be displayed in a browser application. The interface also supports the ability to specify whether the returned images should be transparent so that layers from multiple servers can be combined or not.
- WMC (Web Map Context) specifies how individual map servers describe and provide their map content. The present Context specification states how a specific grouping of one or more maps from one or more map servers can be described in a portable, platform-independent format for storage in a repository or for transmission between clients. This description is known as a "Web Map Context Document," or simply a "Context." Presently, context documents are primarily designed for WMS bindings. However, extensibility is envisioned for binding to other services.

- WMTS (Web Map Tile Service) Implementation Standard provides a standard based solution to serve digital maps using predefined image tiles.
- WPS (Web Processing Service) Interface Standard provides rules for standardizing how inputs and outputs (requests and responses) for geospatial processing services, such as polygon overlay. The standard also defines how a client can request the execution of a process, and how the output from the process is handled. It defines an interface that facilitates the publishing of geospatial processes and clients' discovery of and binding to those processes. The data required by the WPS can be delivered across a network or they can be available at the server.

Directive 2007/2/ES (INSPIRE)

The purpose of the Directive (Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007, Establishing an Infrastructure for Spatial Information in the European Community (INSPIRE)) is to lay down general rules aimed at the establishment of the infrastructure for spatial information in the European Community, for the purposes of Community environmental policies and policies or activities which may have an impact on the environment.

The Directive states which metadata should be included in different spatial data sets. It also sets implementing rules to ensure interoperability of spatial data from different member states. First package of implementing rules was adopted as a Commission Regulation (Commission Regulation (EC) No 1205/2008, of 3 December 2008, implementing Directive 2007/2/EC of the European Parliament and of the Council as regards metadata) and acts as a technical guideline and is based on EN ISO 19115 (Geographic information – Metadata) and EN ISO 19119 (Geographic information – Services) standards.

Second package of implementing rules is to be adopted until 15th of May 2012. The already adopted rules apply to the spatial data sets corresponding to the themes from Annex I of the Directive (coordinate reference systems, geographical grid system, geographical names, administrative units, hydrography etc.), and the second package of implementing rules will apply to the spatial data corresponding to the themes from Annexes II and III. The Annexes II and III include themes, crucial for the CSA, such as elevation, orthoimagery, buildings, land use, human health and safety, environmental monitoring facilities, natural risk zones and other important spatial data themes. So we can conclude that the currently adopted rules are not sufficient and it will take some time until the full adoption of implementing rules.

The current implementing rules set the needed metadata to be included in spatial data sets (corresponding to the themes from Annex I of the Directive). The text and both tables below (taken from the implementing rules, or Commission Regulation (EC) No 1205/2008, of 3 December 2008, implementing Directive 2007/2/EC of the European Parliament and of the Council as regards metadata) show the metadata elements to be included in data sets.

Instructions on multiplicity and conditions of the metadata elements

The metadata describing a resource shall comprise, as regards a spatial data set or a spatial data set series, the metadata elements or groups of metadata elements listed in Table 1 and, as regards a spatial data set service, the metadata elements or groups of metadata elements listed in Table 2.

Those metadata elements or groups of metadata elements shall be in accordance with the expected multiplicity and the related conditions set out in Tables 1 and 2.

When no condition is expressed in relation to a particular metadata element, that element shall be mandatory. The tables present the following information:

- the first column contains the reference to the paragraph in Part B of the Annex defining the metadata element or group of metadata elements,

- the second column contains the name of the metadata element or group of metadata elements,
- the third column specifies the multiplicity of a metadata element. The expression of the multiplicity follows the unified modelling language (UML) notation for multiplicity, in which:
 - 1 means that there shall be only one instance of this metadata element in a result set,
 - 1..* means that there shall be at least one instance of this element in a result set,
 - 0..1 indicates that the presence of the metadata element in a result set is conditional but can occur only once,
 - 0..* indicates that the presence of the metadata element in a result set is conditional but the metadata element may occur once or more,
 - when the multiplicity is 0..1 or 0..*, the condition defines when the metadata elements is mandated,
- the fourth column contains a conditional statement if the multiplicity of the element does not apply to all types of resources. All elements are mandatory in other circumstances.

Table 1: Metadata for spatial data sets and spatial data set series

Reference	Metadata elements	Multiplicity	Condition
1.1	Resource title	1	
1.2	Resource abstract	1	
1.3	Resource type	1	
1.4	Resource locator	0..*	Mandatory if a URL is available to obtain more information on the resource, and/or access related services.
1.5	Unique resource identifier	1..*	
1.7	Resource language	0..*	Mandatory if the resource includes textual information.
2.1	Topic category	1..*	
3	Keyword	1..*	
4.1	Geographic bounding box	1..*	
5	Temporal reference	1..*	
6.1	Lineage	1	
6.2	Spatial resolution	0..*	Mandatory for data sets and data set series if an equivalent scale or a resolution distance can be specified.
7	Conformity	1..*	
8.1	Conditions for access and use	1..*	
8.2	Limitations on public access	1..*	
9	Responsible organisation	1..*	
10.1	Metadata point of contact	1..*	
10.2	Metadata date	1	
10.3	Metadata language	1	

Table 2: Metadata for spatial data services

Reference	Metadata element	Multiplicity	Condition
1.1	Resource title	1	
1.2	Resource abstract	1	
1.3	Resource type	1	
1.4	Resource locator	0..*	Mandatory if linkage to the service is available.
1.6	Coupled resource	0..*	Mandatory if linkage to data sets on which the service operates are available.
2.2	Spatial data service type	1	
3	Keyword	1..*	
4.1	Geographic bounding box	0...*	Mandatory for services with an explicit geographic extent.
5	Temporal reference	1..*	
6.2	Spatial resolution	0..*	Mandatory when there is a restriction on the spatial resolution for this service.
7	Conformity	1..*	
8.1	Conditions for access and use	1..*	
8.2	Limitations on public access	1..*	
9	Responsible organisation	1..*	
10.1	Metadata point of contact	1..*	
10.2	Metadata date	1	
10.3	Metadata language	1	

International Organization for Standardisation (ISO)

For the implementing rules not yet adopted, the spatial data sets could be organized and equipped with metadata according to the ISO standards. There are many standards approved and published by ISO regarding geographic information, but the most important are EN ISO 19115 (Geographic information – Metadata) and EN ISO 19119 (Geographic information – Services).

List of requirements:

- The GIS software (such as ESRI ArcGIS) mostly supports OGC web services necessary for sharing geospatial data via the web (WMS, WCS and WFS).
- To build the CSA system in accordance with the INSPIRE Directive, the system builders will have to be familiar with the Directive and especially with the implementing rules. Sadly the implementing rules concerning metadata to be included in some important data sets for the CSA system have not yet been adopted and probably won't be for quite some time (the deadline being the 15th of May 2012).
- For the lack of implementing rules, the ISO standards could be used to equip the needed spatial data sets with metadata.