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| <b>Title:</b>   |
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| <b>Working Group:</b>   |
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| <b>Short Description:</b>   |
| <p>This document contains the conclusions of the state of the art analysis in spatial data tools and in software architectures. It includes a classification of standards, tools and architectures, which determines their suitability and future application in the HUMBOLDT framework and scenarios. The process for the generation of this document is based on the methodology documented in A3.1 D1.</p> <p>After the delivery of the first version of this document, change requests from the consortium were collected, decided and applied on this deliverable.</p> |
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## Abbreviations

|         |   |
|---------|---|
| AOP     | Aspect-Oriented Programming                             |
| ASCII   | American Standard Code for Information Interchange      |
| CSS     | Cascading Style Sheets                                  |
| CS-W    | Catalogue Service Web                                   |
| DT      | Drafting Team   |
| ECW     | Enhanced Compressed Wavelet                             |
| EJB     | Enterprise Java Beans                                   |
| GIF     | Graphics Interchange Format                             |
| GMES    | Global Monitoring for Environment and Security          |
| GML     | Geography Markup Language                               |
| GUI     | Graphical User Interface                                |
| HTML    | Hypertext Markup Language                               |
| INSPIRE | Infrastructure for Spatial InfoRmation in Europe        |
| ISO     | International Standardisation Organisation              |
| JPA     | Java Persistence API                                    |
| JPEG    | Joint Photographic Experts Group                        |
| MOF     | Managed Object Format                                   |
| OMG     | Object Management Group                                 |
| OGC     | Open Geospatial Consortium                              |
| OPeNDAP | Open-source Project for a Network Data Access Protocol  |
| OR      | Object-Relational                                       |
| OSGA    | Open Grid Service Architecture                          |
| OSGi    | Open Services Gateway initiative                        |
| PNG     | Portable Network Graphics                               |
| PDF     | Portable Document Format                                |
| RCP     | Rich Client Plateform                                   |
| RM-ODP  | Reference Model for Open Distributed Processing         |
| SAGA    | Standards and Architecture for eGovernment Applications |
| SCA     | Service Component Architecture                          |
| SDI     | Spatial Data Infrastructure                             |

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|         |   |
|---------|---|
| SLD     | Styled Layer Descriptor                                   |
| SNV     | Swiss Association of Standardisation                      |
| SOAP    | Simple Object Access Protocol                             |
| SQL     | Structured Query Language                                 |
| THREDDS | Thematic Realtime Environmental Distributed Data Services |
| TIFF    | Tagged Image File Format                                  |
| UDDI    | Universal Description, Discovery and Integration          |
| UML     | Unified Modelling Language                                |
| WCS     | Web Coverage Service                                      |
| WFS     | Web Feature Service                                       |
| XMI     | XML Metadata Interchange                                  |
| XML     | eXtensible Markup Language                                |
| WMS     | Web Map Service   |
| WP      | workpackage   |
| WSDL    | Web Services Description Language                         |
| WS4BPEL | Web Services Business Process Execution Language          |

# 1 Introduction

## 1.1 General Information

The Handbook of standards (WP3 A3.6) is a document, which provides information and recommendations about architectural decisions or rules, standards and tools that should be used within the HUMBOLDT project.

The document will be delivered in 4 versions, so can be treat as a kind of “living” project document. The first version was mainly derived form the state of the art analysis 666, the second version is based on the first version, but includes changes due to refinements or additional information during the first implementation phase.

## 1.2 Content and Purpose

The Handbook of standards aims to provide the development team with valuable recommendations about common architectures styles or rules, standards and tools for their implementation task. The focus of this document is therefore on the technical aspect of HUMBOLDT implementation; the description of concrete standards and libraries include (whenever possible) actual version numbers, profiles and links to internet resources, to be as precise as the development requires.

The document is structured according to the State of the Art Deliverables A3.2-D1 6 and A3.4-D1 6, covering the fields of

- software-architecture,
- standards
- tools.

Recommendations from the state of the art analysis, which forms the base of the document, were not included in this version anymore. The results can be found in the first version of the handbook 6 or in the original documents 66. A set of new standards or changes was provided by the project team during first implementation phase as well as by INSPIRE and GMES work 6.

For consistency reasons the Handbook of standards is not open to edit. But as an interactive development process, a method for update via change requests and regular surveys are described in D 3.1 6 and are shortly explained in this document.

## 1.3 Handbook creation

In the project’s schedule 6 four versions for the Handbook of standards are defined. Version 1 was delivered after month 6, contains mainly the results of the state of art analysis.

Versions 2 (current version) contain further improvements mainly for software related topics, provided by the HUMBOLDT development team. Version 3 (after month 18) and 4 (after month 36) will contain further developments based on current implementations within the project, additional actual trends and input from INSPIRE or GMES related projects.

### 1.3.1 Feedback and change requests

As described, the quantity and quality of the Handbook will deeply depend on feedback from the practical work. This feedback may include missing issues in terms of tools, methods, components, standards, etc., drawbacks in terms of usability, flexibility, security of tools, conflicting versions, data management and harmonisation processes or editorial comments.

To ensure quality of the document, rules for update were postulated in the Description of Work and defined in the Methodology 6. As there is the change management tool “Polarion” introduced in the development team, this tool should also be used for the Handbook of standards.

Every HUMBOLDT project partner is allowed to make a request for change or additional content about the Handbook of standards via the Polarion system. In the phase of the review for the first deliverable, some problems were noted in the use of the Polarion System for Change Requests, so an additional wiki-page for project members was established. Institutions that are not part of the HUMBOLDT consortium may also propose changes, but must address them to the work package leader or to a member of the executive board.

It is always necessary to give adequate information on the change request, including:

- Who wants to change
- What should be changed
- What should be the new content
- When should the change take place (mostly for the next version of document)
- What is the reason for the change
- How could conflicts with previous versions be reduced (first ideas).

All project partners are invited to comment the change request in the tool. The collection of change requests ends 3 months before the release of the new Handbook of standards with a final call for modifications.

After that a decision meeting will take place, where all members are invited. In a voting process the acceptance of every request will be decided. Each project institution will have one vote per request.

## 1.4 Classification applied

For practical work, it is important to assign each standard, tool, method, etc. to a class, depending on their relevance. It is important to note, that this classification does not affect the requirements of the HUMBOLDT project, but give technical recommendations on which standard, tool, method, etc. to choose, when needing to fulfil a specific requirement. E.g. when there will be the need to provide some maps via internet, the WMS standard version 1.1.1 must be used and the WMS standard version 1.3 can be used additionally; when there is no need to provide some maps via internet the WMS standard has not to be used.

Classification:

- “Mandatory”: this standard, tool, method, etc. must be used for the specific usage;
- “Recommended”: should be used (either the standard, tool, method, etc. is regarded as very meaningful or should be tested intensively in order to gain additional experiences);
- “Optional”: the standard, tool, method, etc. can be used additionally to the mandatory or a recommended standard, tool, method, etc.;

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- “Under Observation”: no decision has been made yet, further experiences or developments outside the HUMBOLDT project should be awaited;
- “Outdated”: usage is unadvised because the standard, tool, method, etc. is not up-to-date any more;
- “Prohibited”: standard, tool, method, etc. must not be used, e.g. stated as not stable or incompatible to a mandatory standard, tool, method, etc..

## 2 Towards an HUMBOLDT architecture

General standards or rules for an optimal architecture do not exist. There are standards and best practises to define architectures, standards to model aspects of software system, as well as frameworks and libraries which have strong influence on architectural decisions. The aim of this chapter is to find out the most important ones.

The topic architecture contains:

- general rules/specifications and process models for modelling architectural aspects;
- rules to ensure interoperability (this mainly overlaps with the description of standards within HUMBOLDT);
- libraries or implementation guidelines which should be preferred and therefore influence the design.

### 2.1 Recommendations

#### 2.1.1 Defining architecture

As a helping standard to define architecture for distributed systems, the HUMBOLDT project uses ISO 10746 (Reference Model for open distributed processing RM-ODP). One main topic is the separation of 5 viewpoints to help the grouping the different architectural issues. Another major topic is the definition of different transparencies to decouple responsibilities.

##### **Open Distributed Processing-Reference model-RM-ODP- (mandatory)**

Version: ISO/IEC 10746:1998

Related standards

[url:http://www.iso.org/iso/en/CatalogueDetailPage.CatalogueDetail?CSNUMBER=20696&ICS1=35&ICS2=80&ICS3=](http://www.iso.org/iso/en/CatalogueDetailPage.CatalogueDetail?CSNUMBER=20696&ICS1=35&ICS2=80&ICS3=)

Furthermore UML should be used for different modelling purposes. The actual standard enriches the UML 1 specification with new diagram types. For the exchange the XML Metadata Interchange (XMI) Exchange format can be used. At the current state of discussion, the exchange of models might be by the use of other formats, which offers more complete exchange of models (without losses). These formats would be preferred, so XMI will act as optional standard.

##### **OMG Unified Modelling Language -UML- 2 (mandatory)**

Version: 2.1.1

Related standards:

URL: [http://www.omg.org/technology/documents/modeling\\_spec\\_catalog.htm](http://www.omg.org/technology/documents/modeling_spec_catalog.htm)

Note: Use Case Diagram (mandatory), Class Diagram (mandatory), other types optional

#### **XML Metadata Interchange -XMI- (optional)<sup>1</sup>**

Version: 2.1

Related standards: UML, MOF (Managed Object Format)

URL: [http://www.omg.org/technology/documents/modeling\\_spec\\_catalog.htm](http://www.omg.org/technology/documents/modeling_spec_catalog.htm)

### **2.1.2 Platform**

The platform for the HUMBOLDT Server-Tiers is Java<sup>2</sup>. Depending on the complexity and on servers different parts of J2EE will be used.

#### **Java Standard Edition -JSE- 5 (mandatory)**

Version: 1.5.

Related standards J2EE

URL: <http://java.sun.com/javase/>

#### **Java Enterprise Edition -JEE 5- (optional)**

Version: update 2

Related standards: JSE

URL: <http://java.sun.com/javaee/>

### **2.1.3 Java Libraries**

Based on this theoretical examination, some Java libraries and frameworks seem to be useful for HUMBOLDT. It is mostly difficult to define correct version numbers, because of strong dependency between libraries and the rapid change esp. in common Open Source Projects. The correct versions should be managed within the project.

Frameworks provide general GUI (Graphical User Interface) Elements, plug-in and configuration management for the development of Client applications.

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<sup>1</sup> The exchange of UML models via XMI might cause several losses of content. Therefore it is preferable to use proprietary file formats of the modelling tools for the exchange during software development.

<sup>2</sup> There is an open change request, to add .net as additional platform. The Humboldt "Architecture Team" is currently carrying out tests to examine the use of other, additional platforms within the prototype. Furthermore it will be examined, for what part of the Humboldt system the platform limitations are valid, and what parts only have to fulfil the required interfaces and are independent on the implementation platform.

**Eclipse Rich Client Platform -Eclipse RCP- (recommended)**

Version: Eclipse SDK 3.2.2

Related standards: JSE

URL: <http://www.eclipse.org>

Mostly direct access to relational databases or even file systems can be replaced by object-relational (OR) mapping support. The most popular Java OR-Mapping tool is Hibernate, which is easy to integrate in a complete J2EE environment.

**Hibernate (recommended)**

Version: Hibernate Core 3.2.3

Related standards: JSE, JEE, SQL

URL: <http://www.hibernate.org>

One of the most vivid communities for Java Enterprise Applications is the Spring community. The aim is a simplification of the complex Java Enterprise development, by use of modern techniques and a simplified configuration.

**Spring Framework (optional)**

Version: 2.0.4

Related standards: JSE, JEE

URL: <http://www.springframework.org>

Especially to ensure interoperability between modular Java applications and to help developers, the geoAPI as an OGC supported library provides a collection of actual OGC Standards as Java Interfaces. The open source project geoTools implements these interfaces as complete as possible.

**GeoAPI (recommended)**

Version: 2.0

Related standards: JSE, OGC WFS, WMS, CSW

URL: <http://geoapi.sourceforge.net/>

**GeoTools (recommended)**

Version: 2.3.3

Related standards: JSE, OGC WFS, WMS, CSW

URL: <http://geotools.codehaus.org/>

## 2.1.4 Other Libraries

Although Java is currently the standard platform for the development of Humboldt, some non-Java libraries might offer valuable functionality. So it will be useful to include them in the system. There are several ways to bind their functionality.

GDAL/OGR is a basic library for manipulation like reprojection, creation, data extraction, conversion etc. of raster and vector data formats. It is implemented in C, used in several open source projects and has got several bindings to other languages.

### **GDAL/OGR (recommended)**

Version: 1.4.2

Related standards: OGC standards, geotools, geoAPI

URL: <http://www.gdal.org/>

## 3 Standards for HUMBOLDT

The given standards are intended to allow interoperability between components. These standards define mainly the used file formats, interfaces between components or ways to communicate.

### 3.1 Recommendations

Most recommendations are directly derived from the state of the art analysis. They are based on the prior knowledge and the common definitions in existing spatial data infrastructures. These standards were reviewed and completed during the last 6 month by HUMBOLDT project members. Further changes are expected during the next phase, when more experiences are collected during the implementation of the prototype and the framework.

Especially for the standards, interoperability, stability and functionality should be observed and problems should result in a request for change.

#### 3.1.1 Standards for GIS

##### 3.1.1.1 Services

##### *Catalogue Service for Geodata*

The usage of the OGC standard will allow interoperable search for metadata of different types, when the profiles are defined proper. Currently there is no profile defined. INSPIRE Metadata DT has defined a profile of ISO 19115 for discovery metadata; this might be adequate, but have to be examined.

### **OGC Catalogue Service Web -CSW-2 (mandatory)<sup>3</sup>**

<sup>3</sup> The first version of the prototype will be based on previous version (2.0.1) due to lack of tools implementing the 2.0.2 at this time.

Currently no profile is defined for HUMBOLDT

Version: 2.0.2

Related standards: ISO 19115, ISO 19119, ISO 19139

URL: [http://portal.opengeospatial.org/files/?artifact\\_id=20555](http://portal.opengeospatial.org/files/?artifact_id=20555)

### ***Feature Service***

The access to features can be either transactional or simply requesting. The OGC standard is quite popular, but sometimes limited in the functionality, e.g. for joined features. The structure of the features is not part of the standard.

#### **OGC Web Feature Service -WFS- 1.1 (mandatory)**

**Version: 1.1**

Related standards: WMS, SLD (Styled Layer Descriptor)

URL: [https://portal.opengeospatial.org/files/?artifact\\_id=8339](https://portal.opengeospatial.org/files/?artifact_id=8339)

To select features like in a “select” clause the Filter encoding was defined by OGC as XML.

#### **OGC Filter Encoding 1.1 (mandatory)**

**Version: 1.1**

Related standards: WFS, SLD

url: [http://portal.opengeospatial.org/files/?artifact\\_id=8340](http://portal.opengeospatial.org/files/?artifact_id=8340)

### ***Raster Data Service***

Raster data, e.g. multidimensional satellite data or topographic data, can be obtained by the use of OGC Web Coverage Service.

#### **OGC Web Coverage Service -WCS- 1.1.0 (mandatory)**

Version: 1.1.0

Related standards: WMS, SLD

URL: [https://portal.opengeospatial.org/files/?artifact\\_id=18153](https://portal.opengeospatial.org/files/?artifact_id=18153)

### ***Mapping Service***

The popular OGC Web Map Service can produce images. The additional functionalities are getCapabilities to describe the Service and getInfo to produce some information for a location. The structure of the information is not part of the standard. The mostly used versions are 1.0 and 1.1; the actual 1.3 standard allows the usage of named SLDs.

#### **OGC Web Map Service -WMS- 1.1.1 (mandatory)**

Version: 1.1.1

Related standards: WMC, WFS, SLD

URL: [http://portal.opengeospatial.org/files/?artifact\\_id=1081&version=1&format=pdf](http://portal.opengeospatial.org/files/?artifact_id=1081&version=1&format=pdf)

Additional specifications:

- img/png must be provided
- transparency must be supported
- legend-image must be available (at least an image indicating: “*layername: no legend available*”),
- if getFeatureInfo is available, there must be at least a text/html formatted response

#### **OGC Web Map Service -WMS- 1.3 (optional)**

Version: 1.3

Related standards: WMC, WFS, SLD

URL: [http://portal.opengeospatial.org/files/?artifact\\_id=4756](http://portal.opengeospatial.org/files/?artifact_id=4756)

#### **OGC Styled Layer Descriptor Profile of the Web Map Service 1.1 (optional)**

Version: 1.1

Related standards: WMS, WCS, WFS, SLD

url: [http://portal.opengeospatial.org/files/?artifact\\_id=12637](http://portal.opengeospatial.org/files/?artifact_id=12637)

The additional specification of the context for WMS, the Web Map Context Document, allows to store information of a map context based on different servers and layers for defined extends, reference systems, etc..

#### **OGC Web Map Context Document -WMC- 1.1 (optional)**

Version: 1.1

Related standards: WMS

url: [http://portal.opengeospatial.org/files/?artifact\\_id=8618](http://portal.opengeospatial.org/files/?artifact_id=8618)

#### **Style Description**

The Styled Layer Descriptor which is used for rendering is defined in context with WFS, WMS and WCS. To separate the style description from the WMS specific functionality, the follow up of SLD is the combination of the SLD Profile for WMS 1.1 and the Symbology Encoding

#### **OGC Styled Layer Descriptor -SLD- 1.0 (mandatory)**

Related standards: WMS, WFS, WCS, Filter Encoding

url: [http://portal.opengeospatial.org/files/?artifact\\_id=1188](http://portal.opengeospatial.org/files/?artifact_id=1188)

#### **OGC Symbology Encoding – SE 1.1.0 (optional)**

Version: 1.1.0

Related standards: Styled Layer Descriptor Profile of the Web Map Service 1.1, WMS

url: [http://portal.opengeospatial.org/files/?artifact\\_id=16700](http://portal.opengeospatial.org/files/?artifact_id=16700)

### 3.1.1.2 Data

#### *Metadata*

The metadata for geodata and geoservices is mainly used by the catalogue system. The definition of the contents is defined by the ISO standards 19115 (Geographic information - Metadata) and the XML representation by ISO 19139. ISO 19119 (Geographic information - Services) defines patterns for service interfaces used for geographic information.

#### **ISO 19115 “Geographic Information - Metadata” (mandatory)**

Version: ISO 19115:2003/Cor 1:2006

Related standards: ISO 19139

URL:

<http://www.iso.org/iso/en/CatalogueDetailPage.CatalogueDetail?CSNUMBER=44361&scopelist=>

Note: There are inconsistencies between ISO 19115 and ISO 19139. The Technical Specification ISO 19139 provides a more reliable (better to implement) definition of the metadata schema than ISO 19115. Therefore, ISO 19139 should be used.

#### **ISO 19119 “Geographic Information - Services” (mandatory)**

Version: ISO 19119:2005

Related standards: -

URL:

<http://www.iso.org/iso/en/CatalogueDetailPage.CatalogueDetail?CSNUMBER=39890&scopelist=>

#### **ISO 19139 “Geographic information - Metadata - XML schema implementation” (mandatory)**

Version: ISO/TS 19139:2007

Related standards: ISO 19115

URL:

<http://www.iso.org/iso/en/CatalogueDetailPage.CatalogueDetail?CSNUMBER=32557&ICS1=35&ICS2=240&ICS3=70>

Not with a focus on geodata the Dublin Core Metadata Initiative defines standardised and extensible metadata for general documents (focus on Internet). The 15 elements were adopted by ISO. The information can be provided as RDF/XML or Meta Tags within the HTML-header.

**ISO 15836 “Information and documentation - The Dublin Core metadata element set” (optional)**

Version: ISO 15836

Related standards: -

URL:

<http://www.iso.org/iso/en/CatalogueDetailPage.CatalogueDetail?CSNUMBER=37629&ICS1=35&ICS2=240&ICS3=30>

***Modelling of geodata***

The modelling of geodata is crucial for the harmonisation of different contents. There are different approaches with different goals. As the modelling of geodata is a critical point within the project, currently no standards are marked mandatory.

The INTERLIS approach is based on the harmonisation efforts of the Swiss government. It is a textual, conceptual modelling language with a special focus on geodata.

**INTERLIS 2 - (Swiss standard SN612031, ed. 2006-05) (recommended)**

Version: 2.3

Related standards: -

URL: <http://www.interlis.ch/content/index.php?language=e>

The widely used modelling language for the description of general (software) systems is UML. For data modelling, the main diagram type is the class model. As it is not sufficient to model geodata, some efforts were made to extend UML (e.g. GeoUML, UGAS, INTERLIS UML modeller).

**OMG Unified Modelling Language -UML- 2 (recommended)**

Version: 2.1.1

Related standards: -

URL: [http://www.omg.org/technology/documents/modeling\\_spec\\_catalog.htm](http://www.omg.org/technology/documents/modeling_spec_catalog.htm)

The ISO committee provides guideline and rules for the use of conceptual schema languages for geographic data.

**ISO 19103 “Geographic information - Conceptual schema language” (recommended)**

Version: ISO TS 19103:2005

Related standards: UML, INTERLIS

URL:

<http://www.iso.org/iso/en/CatalogueDetailPage.CatalogueDetail?CSNUMBER=37800&scopelist=>

The ISO 19109 provides rules for defining application schemas, without the definition of the conceptual languages to be used.

**ISO 19109 “Geographic information—Rules for application schema” (recommended)**

Version: ISO 19109:2005

Related standards: -

URL:

<http://www.iso.org/iso/en/CatalogueDetailPage.CatalogueDetail?CSNUMBER=39891&ICS1=35&ICS2=240&ICS3=70>

The Inspire drafting team on "Data Specifications" collected the requirements to a conceptual modelling language.

**Generic Conceptual Model – GCM (under observation)**

Version: Inspire drafting team “Data specification” D2.5

Related standards: UML, Interlis

URL:

**Vector formats**

GML provides a XML schema to build XML documents with geographic content.

**OGC Geography Markup Language -GML- 3 (mandatory)**

Version: 3.1.1

Related standards: many OGC standards use GML

URL: [http://portal.opengeospatial.org/files/?artifact\\_id=4700](http://portal.opengeospatial.org/files/?artifact_id=4700)

**Raster formats**

For the transfer of raster data, e.g. for the use of WCS, several formats can be used.

**Geo Tagged Image File Format GeoTIFF<sup>4</sup> (mandatory)**

Version: 1.0

Related standards: WCS

URL: <http://remotesensing.org/geotiff/geotiff.html>

**Hierarchical Data Format - Earth Observation Systems -HDF-EOS- (optional)**

Version: 5

Related standards: WCS

URL: <http://hdf.ncsa.uiuc.edu/hdfeos.html>

<sup>4</sup> GeoTIFF as mandatory format has got some limitations, esp. in the handling of large file-sizes or the need for efficient compressions. Nevertheless a mandatory raster format will increase system compatibility. So at current state, further raster formats will be evaluated to find out the best mandatory format and its limitations.

**Digital Terrain Elevation Data -DTED- (optional)**

Version:

Related standards: WCS

URL: [http://www.nima.mil/publications/specs/printed/89020A/89020A\\_DTED.pdf](http://www.nima.mil/publications/specs/printed/89020A/89020A_DTED.pdf)

**National Imagery Transmission Format -NITF- (optional)**

Version:

Related standards: WCS

URL: <http://www.ismc.nima.mil/ntb/baseline/1999.html>

**Network Common Data Form - NetCDF (optional)**

Version: 3

Related standards: COARDS/CF 1.0 (convention for climate and forecast metadata)

URL for netCDF: <http://www.unidata.ucar.edu/software/netcdf/>

URL for COARDS convention: [http://ferret.wrc.noaa.gov/noaa\\_coop/coop\\_cdf\\_profile.html](http://ferret.wrc.noaa.gov/noaa_coop/coop_cdf_profile.html)

URL for CF convention: <http://www.cfconventions.org/>

**Additional**

Accessing geographic data from SQL-Databases should be made by use of the OGC defined Simple Features Access. The simple features are adopted by ISO.

**ISO 19125 “Geographic information—Simple feature access—Part 1: Common architecture” (optional)**

Version: ISO 19125-1:2004

Related standards: -

URL:

<http://www.iso.org/iso/en/CatalogueDetailPage.CatalogueDetail?CSNUMBER=40114&ICS1=35&ICS2=240&ICS3=70>

**ISO 19125 “Geographic information—Simple feature access—Part 2: SQL option” (optional)**

Version: ISO 19125-2:2004

Related standards: -

URL:

<http://www.iso.org/iso/en/CatalogueDetailPage.CatalogueDetail?CSNUMBER=40115&ICS1=35&ICS2=240&ICS3=70>

### 3.1.2 “Non-geographic” standards

Several non-geographic services and data will be used within the HUMBOLDT project. So a set of general standards will be provided.

#### 3.1.2.1 Services/Communication

The communication within services will not be defined now; but standards for the communication via Web Services. The simple object access protocol defines the protocol for a communication via XML- Documents (http). Web service definition language (WSDL) describes services (mainly SOAP), with their important contents, e.g. interface and access. The Universal Description, Discovery and Integration (UDDI) is a SOAP service to lookup services which are provided.

##### **Simple Object Access Protocol -SOAP- 1.1 (mandatory)**

Version: 1.1

Related standards: WSDL

URL: <http://www.w3.org/TR/soap/>

##### **Simple Object Access Protocol -SOAP- 1.2 (under observation)**

Version: 1.2 - 27 April 2007

Related standards: WSDL

URL: <http://www.w3.org/TR/soap/>

##### **Web Services Description Language -WSDL- 1.1 (mandatory)**

Version: 1.1

Related standards: SOAP

URL: <http://www.w3.org/TR/wsdl>

##### **Web Services Description Language -WSDL- 2.0 (under observation)**

Version: 2.0 - 26 March 2007

Related standards: SOAP

URL: <http://www.w3.org/TR/wsdl20/>

##### **Universal Description, Discovery and Integration -UDDI- (under observation)<sup>5, 6</sup>**

<sup>5</sup> Remark: In the current document from INSPIRE NS DT “Implementing Rule for discovery and view services”, UDDI is not recommended.

<sup>6</sup> The Implementation Team will critically examine the UDDI standard for the use within the project.

Version: 3.0.2

Related standards: SOAP

URL: [http://http://uddi.org/pubs/uddi\\_v3.htm](http://http://uddi.org/pubs/uddi_v3.htm)

### 3.1.2.2 XML related

As currently most file-formats, services, configurations are XML based, the actual or stable versions of the main standards XML, XSD and XSLT are noted.

#### **eXtensible Markup Language -XML- 1.0 (mandatory)**

Version: 1.0 (Fourth Edition)

Related standards: XSD, XSLT, most OGC standards

URL: <http://www.w3.org/TR/2006/REC-xml-20060816/>

#### **XML Schema -XSD- 1.0 (mandatory)**

Version: 1.0

Related standards: XML

URL: <http://www.w3.org/XML/Schema>

#### **XML Schema -XSD- 1.1 (under observation)**

Version: 1.1 (working draft)

Related standards: XML

URL: <http://www.w3.org/TR/xmlschema11-1/>

#### **XSL Transformations -XSLT- 1.0 (mandatory)**

Version: 1.0

Related standards: XML

URL: <http://www.w3.org/TR/xslt>

#### **XSL Transformations -XSLT- 2.0 (under observation)**

Version: 2.0

Related standards: XML

URL: <http://www.w3.org/TR/2007/REC-xslt20-20070123/>

### 3.1.2.3 Standard file types

In contrary to Chapter 3.2.1.2 where the GIS-specific formats have been described (e.g. GeoTIFF), the following chapter deals with the “usual” formats that are not primarily GIS-relevant (e.g. TIFF).

#### *Images*

Formats for images are mostly not crucial, when displayed on a client. Sometimes problems came up when rendering on servers or fat clients (e.g. overlay in MapServers, handling of transparencies).

- Image formats for small pictures or reduced colour depth

The GIF format supports only 256 colours and transparency, but is established as a standard for web images. The newer PNG supports full colour range, transparency and allows progressive loading. The compression is not as good as JPEG, so the size for large images (esp. photos) is not very good.

#### **Graphics Interchange Format -GIF- (mandatory)**

Version: gif 89a

URL: <http://www.w3.org/Graphics/GIF/spec-gif89a.txt>

#### **Portable Network Graphics -PNG- (mandatory)**

Version: ISO/IEC 15948:2003

URL: <http://www.w3.org/TR/PNG/>

- Image formats for large images, especially photos  
The JPEG format is the internet standard for photos; it allows the storage with full colour range, progressive image loading and variable good compression rates. The loss of information is obvious in areas of high contrast. The TIFF format is quite more complex, but supports compression with/without losses, transparencies, multi-image files, etc.. This complexity quite often results in problems on interoperability. TIFF is the internet standard for high-quality images.

#### **Joint Photographic Experts Group -JPEG- (mandatory)**

Version: ISO 10918-1

URL: <http://www.w3.org/Graphics/JPEG/itu-t81.pdf>

#### **Tagged Image File Format -TIFF- (mandatory)**

Version: 6.0

URL: <http://partners.adobe.com/public/developer/tiff/index.html>

- Special file formats for large images  
ECW (Enhanced Compressed Wavelet) allows high compression of images with minimal data transfer on zooming, panning as a combination of image tiling, wavelet compression and a streaming support. ECW needs plug-ins on the client side. With multi-layers and georeferencing ECW is well suited for aerial photos and satellite images. JPEG2000 is similar in technique, but currently not widely accepted.

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**Enhanced Compressed Wavelet -ECW- (optional)**

Version: -

URL: <http://www.ermapper.com>

**Joint Photographic Experts Group -JPEG2000- (optional)**

Version: -

URL: <http://www.jpeg.org/jpeg2000/>

-Vector Format for the visualisation of Vector Data

**Scalable Vector Graphics –SVG 1.1 (optional)**

Version: 1.1

Related Standards:

URL: <http://www.w3.org/TR/SVG11/>

**Documents**

Textual information is often needed with different backgrounds. The standard for internet pages is HTML with the optional CSS (Cascading Style Sheets). For the presentation of large documents in a printable form, mostly PDF is used. Although special software is needed, the format is standard for internet. Furthermore simple Text-files without formatting are mostly handled as ASCII Text files.

**Hypertext Markup Language -HTML- (mandatory)**

Version: 4.0.1

URL: <http://www.w3.org/TR/html4/>

**Cascading Style Sheets –CSS- (mandatory)**

Version: 2.1

URL: <http://www.w3.org/TR/CSS21/>

**eXtensible Hypertext Markup Language –XHTML- (optional)**

Version: 1.0

URL: <http://www.w3.org/TR/xhtml1/>

**Portable Document Format -PDF- (recommended)**

Version: 1.6

URL: <http://www.adobe.com/devnet/pdf/pdfs/PDFReference16.pdf>

### **Compression**

Sometimes the amount of data needs to be reduced. Common standards for compression are ZIP or GZIP.

#### **ZIP (mandatory)**

Version: 2.0

URL: [http://www.pkware.com/index.php?option=com\\_content&task=view&id=64&Itemid=107](http://www.pkware.com/index.php?option=com_content&task=view&id=64&Itemid=107)

## **4 Candidate tools for HUMBOLDT**

Tools for HUMBOLDT are quite different from standards or architectural issues. Tools are mostly used interactive and their interoperability is mostly not as crucial as for libraries. But for the work in a big consortium, it is often helpful to work with same tools. The focus on the tools analysis is clearly on harmonisation, data modelling and partly on standard components for spatial data infrastructures.

### **4.1 Recommendations**

The tools for the first version of the A3.6 are directly derived from the state of the art analysis. In the actual and in further versions of this document, the results of the tests and evaluations of tools are considered for these recommendations and involved some changes.

The tools presented in this chapter are grouped by functional aspects. For more information about these tools please refer to the Annex I for WP 3.2 D1 6.

Tests should evaluate the components within a suite in order to identify potential conflicts between modules. HUMBOLDT shall then recommend one or several suites and point out known conflicts between individual components.

#### **4.1.1 Tools for data modelling and harmonisation**

The “INTERLIS Tools” provide a complete set of tools to model geographic data, map different data models and perform data exchange on basis of this mapping.

##### **INTERLIS Tools (recommended)**

Version: INTERLIS 2

URL: <http://www.infogrips.ch>, <http://www.interlis.ch>

List of INTERLIS Tools:

|  |                 |
|--|-----------------|
| <b>INTERLIS</b><br>Generation of conceptual data models, generation of transfer formats (e.g. GML)   | <b>compiler</b> |
| <b>INTERLIS</b><br>Consistency checking of data model and data; topologic consistency checks   | <b>checker</b>  |
| <b>UML/INTERLIS</b><br>Generation of UML based application schemas (data models) and conversion to INTERLIS  | <b>Editor</b>   |
| <b>INTERLIS FME module and FME INTERLIS tools, or INTERLIS studio</b><br>Reading INTERLIS files and subsequent schema mapping (followed by automatically generated data structure or format mapping) |                 |

A Tool for changing ISO-19109 UML-models to GML Application Schemas is UGAS-ShapeChange. It must be provided with an adequate UML Model in XMI format and configuration files.

|  |
|--|
| <b>UGAS (ShapeChange) (recommended)</b><br>Version 0.3 (Oct 2005) (or newer)<br>URL: <a href="http://www.interactive-instruments.de/ugas/">http://www.interactive-instruments.de/ugas/</a> |
|--|

Modelling of data on different levels of abstraction will be often necessary in HUMBOLDT. There is a recommendation for a commercial UML-Tool, which is also in use at the INSPIRE “data specification” DT, and a recommendation for a very often used Ontology Editor.

|  |
|--|
| <b>Enterprise Architect (recommended)</b><br>Version: 6.5 (or newer)<br>URL: <a href="http://www.sparxsystems.com/">http://www.sparxsystems.com/</a> |
|--|

|   |
|---|
| <b>Protégé (recommended)</b><br>Version: 3.2.1 (or newer)<br>URL: <a href="http://protege.stanford.edu/">http://protege.stanford.edu/</a> |
|---|

#### 4.1.2 Tools for data and metadata management

For Metadata there is a wide range of OGC/ISO compatible servers. With GeoNetwork and Micka, two are picked. A special functionality in modelling metadata has got CatMDEdit.

|   |
|---|
| <b>GeoNetwork (recommended)</b><br>Version: 2.1 beta (or newer)<br>URL: <a href="http://sourceforge.net/projects/geonetwork">http://sourceforge.net/projects/geonetwork</a> |
|---|

|  |
|--|
| <b>Micka Metadata and catalogue system (recommended)</b> |
|--|

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Version: -

URL: <http://www.bnhelp.cz/metadata2/catClient.php>

**CatMDEdit (recommended)**

Version: 3.8 (or newer)

URL: <http://catmdegit.sourceforge.net/>

GeoMedia Tools from Intergraph, a WP3 partner, are recommended as the general commercial component based GIS software, with packages for analysis and visualisation.

**GeoMedia Tools (recommended)**

Version: 6.0 (or newer)

URL: <http://www.intergraph.com/geomedia/>

#### 4.1.3 Tools for publication, access and visualisation

This section mainly contains popular Mapserver applications. It is worth to notice them, because they form a prominent part of SDI. The most prominent is the UMN Mapserver from the university of Minnesota. With a long tradition, this server is often used, fast and stable, but offers only WMS. Degree and GeoServer are based on huge Java libraries and are both stable and support WMS, WFS, WCS and SLD.

**UMN Mapserver (recommended)**

Version: 4.6 (or newer)

URL: <http://ms.gis.umn.edu/>

**GeoServer (recommended)**

Version: 1.6.0 beta (or newer)

URL: <http://docs.codehaus.org/display/GEOS/Home>

**Degree (recommended)**

Version: 2 (or newer)

URL: <http://www.degree.org/>

The THREDDS/OPeNDAP Server is well established in several application domains and form a de-facto standard solution for the access of large volume raster data.

**THREDDS/OPeNDAP (Thematic Realtime Environmental Distributed Data Services) (optional)**

Version: 1 (or newer)

Related standards: WCS, NetCDF

URL for THREDDS: <http://www.unidata.ucar.edu/projects/THREDDS/>

URL for OPendap: <http://www.opendap.org/>

#### 4.1.4 Client Tools

The proposed standards for the Humboldt projects often offer a server and a client interface. Whilst servers are a more critical part in Humboldt framework or applications and therefore are rated by the classification system, the following section of suitable clients is not rated and has only informational character.

The list of tools is very limited and only client software examined in more detail by the Humboldt consortium is added. More complete lists can be found in several Internet Listings.<sup>7</sup>

##### 4.1.4.1 Free/Open Source GIS Clients

###### *Fat Clients or standalone applications*

###### **Udig (User-friendly Desktop Internet GIS)**

Version: 1.1

Related standards: WFS (transactional), WMS, Java, GeoTools

URL: <http://udig.refrations.net/confluence/display/UDIG/Home>

Udig is a simple Java GIS based on Eclipse IDE and the GeoTools API. Additionally to the standard interfaces, several formats or DBs are supported.

###### **Qgis (Quantum GIS)**

Version: 0.8.1

Related standards: WMS

URL: <http://www.qgis.org/>

QGIS is available for different platforms. Supports a variety of different formats or DBs.

###### *Thin or web clients*

###### **Openlayers**

Version 2.4

Related standards: WMS, WFS

URL: <http://www.openlayers.org/>

Openlayers is a lightweight JavaScript based Mapviewer.

<sup>7</sup><http://freegis.org/>, [http://en.giswiki.org/wiki/Liste\\_Tools](http://en.giswiki.org/wiki/Liste_Tools), [http://en.wikipedia.org/wiki/List\\_of\\_GIS\\_software](http://en.wikipedia.org/wiki/List_of_GIS_software),

### **Mapbender**

Version: 2.4

Related standards: WMS, WFS

URL: <http://www.mapbender.org>

Mapbender is based on PHP and JavaScript.

## **5 Conclusions and outcomes**

The recommendations for architecture, standards and tools form the outcome for the Handbook of Standards. Nevertheless, some critical remarks must be included.

- Incompleteness:  
The documents for the state of the art analysis, on which this Handbook version is built, have been collected by the HUMBOLDT project partners. In spite of the wide range and heterogeneity of the partners it cannot be excluded that important documents could have been overlooked. At state of the current version, the prototype development is still not in the implementation phase, so that we expect for further releases of the handbook additional changes due to implementation experiences. Also major input is expected from the related, ongoing projects within the context of INSPIRE and GMES. The new section for client tools is still in an early phase. It is not intended to have a complete list on this section, as well as in the other tool sections, but to show proven components.
- Version problems:  
While the versions of international standards (ISO) are mostly of a longer duration of validity, the standards related to Spatial Data Infrastructures (often OGC standards) or open internet standards are quite often in change. This results often in problems for defining valid versions and profiles for a long running project like HUMBOLDT. It is expected for many standards within this document to change versions during the project. Whilst the standards are mostly crucial in the version compatibility, the tools are mostly marked with a minimum version to handle the mandatory or recommended standards.
- Software Libraries  
Some libraries, respectively frameworks are included in the Handbook of standards. These libraries are included subjectively, because they were guessed to be relevant for further decisions, like architectural issues, or they offer very HUMBOLDT specific functionality. Other libraries, although in fact standards, e.g. logging libs, parsers etc. are not included. The management of libraries and actual versions are in responsibility of the implementation team.

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