ISO/TC 211 Workshop
Standards in Action

Swiss Contribution
Overview

• Introduction
  History of Geostandards in Switzerland

• Standards in Action
  Examples of ISO/TC211 Standards Applications

• Summary and Outlook
  Experiences and Results
Introduction

History of Geostandards in Switzerland
Introduction

- Motivation for using a Geostandard in Switzerland
Introduction

- Motivation for using a Geostandard in Switzerland
Introduction

History:

1985  development of model-based Geostandard (INTERLIS 1)

1992  Swiss law: use standard for the documentation of land surveying data

1992 - 2000  development of conceptual models for various application domains, corresponding data acquisition followed by data transfer between different GIS

1998 - 2000  development of second version of standard (INTERLIS 2) based on current IT, and experiences with INTERLIS 1, and requirements of ISO/TC211, PT CSL
Introduction

• What is INTERLIS?
  • A conceptual schema language
  • A sequential transfer format
  • Encoding rules (XML)

Data description:

```
DATA MODEL =

DOMAIN
  Point2D = COORD2 111.11 222.22

TOPIC T =
  CLASS C =
    Attr1: TEXT*12;
    Attr2: Point2D;
    ...
```

Data transfer format:

```
<Grunddatensatz_Fixpunkte_LFP>
  <Grunddatensatz_Fixpunkte_LFP_OBJE
    TID="T101" Art="LFP1" LageZuv="ja"
    HoeheGen="0.0" Nummer="1091111.2"
    Geometrie="675899.226/245270.946"
    LageGen="0.0"
    NumPos="675895.761/245263.124"
    HoeheZuv="ja"
  />
<Grunddatensatz_Fixpunkte_LFP_OBJE
```

Building:
• Number, Street
• Geometry
Introduction

Model-based Geodata transfer from GIS A to GIS B

Structure of the transfer file:
Introduction

Model-based Geodata transfer from GIS A to GIS B

Structure of the transfer file:
first data model
Introduction

Model-based Geodata transfer from GIS A to GIS B

Structure of the transfer file:
first data model
then data

From the data model
the transfer format can be derived
Introduction
Introduction
Introduction

• Experiences
  • Model-based approach is suitable for GIS data transfer:
    • standards can be independent of any application
    • Data once captured need not be recaptured if system changes
    • Freedom of implementation for system developers and freedom of the users to chose the best system
    • Reusability of data, interoperability of systems
Introduction

• Experiences
  • INTERLIS 1 has several disadvantages:
    • no possibility for class and type extensions (OO)
    • no incremental update
    • not XML-based
    • no unit and co-ordinate reference types
    • no multi-lingual support
    • OID specification missing
    • not conform to ISO 19100
Standards in Action

Examples of ISO/TC211 Standards Applications
# Standards in Action

**History:**

<table>
<thead>
<tr>
<th>Year</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1985</td>
<td>development of model-based Geostandard (INTERLIS 1)</td>
</tr>
<tr>
<td>1992</td>
<td>Swiss law: use standard for the documentation of land surveying data</td>
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<td>development of second version of standard (INTERLIS 2) based on current IT, and experiences with INTERLIS 1, and requirements of ISO/TC211, PT CSL</td>
</tr>
</tbody>
</table>
ISO 19118.2 Figure 2: Overview of the encoding process

Scope of INTERLIS Specification
Scope of Applications
Scope of GIS

Standards in Action

Schema language

Conceptual schema language $C$

Encoding rule $R$

Conceptual schema language $D$

Application schema $I$

Encoding service

Data structure schema $D$

Instances

Input $i$

Output $d$

Defines

Data flow

Relationship
Standards in Action
Implementation of the Encoding Process in Switzerland

Conceptual schema language

Application schema A

Encoding service

Interlis Encoding rules

Common data structure schema

Decoding service

Application schema B

DB Input I System A

Exchange data Output O

DB Input I System B

Exchange data Output O

Reality

Y derived from X

X defines Y

Data I/O
## Standards in Action

<table>
<thead>
<tr>
<th>INTERLIS-CSL</th>
<th>UML Element</th>
</tr>
</thead>
<tbody>
<tr>
<td>MODEL</td>
<td>Package(s)</td>
</tr>
<tr>
<td>TOPIC</td>
<td>Package in package</td>
</tr>
<tr>
<td>CLASS</td>
<td>Class</td>
</tr>
<tr>
<td>CLASS (ABSTRACT)</td>
<td>Abstract class</td>
</tr>
<tr>
<td>-&gt; (Association)</td>
<td>Association</td>
</tr>
<tr>
<td>-&lt;&gt; (Aggregation)</td>
<td>Aggregation Association</td>
</tr>
<tr>
<td>LIST OF, BAG OF</td>
<td>Composition Association</td>
</tr>
<tr>
<td>CLASS A EXTENDS B</td>
<td>Generalization</td>
</tr>
</tbody>
</table>
# Standards in Action

<table>
<thead>
<tr>
<th>No.</th>
<th>ISO document title</th>
<th>INTERLIS part</th>
</tr>
</thead>
<tbody>
<tr>
<td>19101</td>
<td>Reference model</td>
<td>Chap. 1, chap. 2</td>
</tr>
<tr>
<td>19109</td>
<td>Rules for application schema</td>
<td>Chap. 1 + user manual</td>
</tr>
<tr>
<td>19103</td>
<td>Conceptual schema language (CSL)</td>
<td>Chap. 2 CSL</td>
</tr>
<tr>
<td>19107</td>
<td>Spatial schema</td>
<td>Geometric data types</td>
</tr>
<tr>
<td>19103</td>
<td>CSL (+Object Constraint L.)</td>
<td>Constraints + Logical Expr.</td>
</tr>
<tr>
<td>19108</td>
<td>Temporal schema</td>
<td>Units + Ref.Sys, etc. ...</td>
</tr>
<tr>
<td>19111</td>
<td>Spatial ref. by coord.</td>
<td>Reference system (CRS)</td>
</tr>
<tr>
<td>?</td>
<td>?</td>
<td>Views (~ SQL92)</td>
</tr>
<tr>
<td>19117</td>
<td>Portrayal</td>
<td>Graphic description + symb.</td>
</tr>
<tr>
<td>19118</td>
<td>Encoding</td>
<td>Seq. transfer + update</td>
</tr>
</tbody>
</table>
# Standards in Action

<table>
<thead>
<tr>
<th>ISO 19107 Spatial Schema</th>
<th>INTERLIS data types</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>GM_Point</td>
<td>COORD2, 3, ...</td>
<td>-</td>
</tr>
<tr>
<td>GM_Curve</td>
<td>POLYLINE WITH...</td>
<td>POLYLINE can be mapped to several GMx</td>
</tr>
<tr>
<td>GM_LineString</td>
<td>SURFACE WITH...</td>
<td>SURFACE can be mapped to several GMx</td>
</tr>
<tr>
<td>GM_GenericSurface</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GM_Surface</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GM_SurfacePatch</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GM_Polygon</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GM_MultiPoint, Curve</td>
<td>Not defined</td>
<td>user definable, done with compositions</td>
</tr>
<tr>
<td>GM_MultiLineString</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GM_MultiSurface</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TP_Face</td>
<td>AREA WITH ...</td>
<td>-</td>
</tr>
<tr>
<td>TP_Solid</td>
<td>definable with classes</td>
<td>-</td>
</tr>
</tbody>
</table>
Standards in Action

• Example
  • Data modeling with UML
  • UML-input and data model refinement in INTERLIS
  • INTERLIS compiler produces output data model as XML Schema/DTD (+ empty data section)
  • Data consistent to defined data model in XML(-DTD + data section)
Standards in Action

Example: UML ➔ INTERLIS
Example: INTERLIS schema

```
!! Version 2000-03-26
INTERLIS 2.0: LANGUAGE en. !! 2-letter code (ISO 639)
DATA MODEL Road2Example =
  DOMAIN
    Point2D = COORD 0.000 .. 200.000.1 Min_East Max_East
    0.000 .. 200.000.1 Min_North Max_North
    ROTATION 2 -> 1;
  Orientation = 0.0 .. 360.0;
  TOPIC Roads =
    CLASS LandCover =
      Type: MANDATORY (building, street, water, other);
      Geometry: MANDATORY SURFACE WITH (STRAIGHTS) VERTEX Point2D
      WITHOUT OVERLAPS > 0.100;
      END LandCover;
    CLASS Street =
      Name: MANDATORY TEXT*32;
      END Street;
  CLASS StreetAxis =
    Street: MANDATORY -> Street
    Geometry: MANDATORY POLYLINE WITH (STRAIGHTS) VERTEX Point2D;
    Precision: MANDATORY (precise, imprecise);
    END StreetAxis;
    CLASS StreetNamePosition =
      Street: MANDATORY -> Street;
      NamePos: MANDATORY Point2D;
      NameOri: MANDATORY Orientation;
      END StreetNamePosition;
    CLASS PointObject =
      Type: MANDATORY (tree, geodetic_point, other);
      Position: MANDATORY Point2D;
      END PointObject;
  END Roads: !! of TOPIC
```
Standards in Action

Example: compile INTERLIS ➔ XML (or DTD or XML Schema)

ili2 compiler

ili to DTD
Standards in Action

Example: corresponding XML data

```xml
<DATASECTION>
  <RoadsExample-Roads_BASKETID="B1">
    <RoadsExample-Roads_LandCover_TID="B1.16" Type="water">
      <RoadsExample-Roads_LandCover_Geometry>
        <SURFACE>
          <POLYLINE>
            <LINEATTR>
              <RoadsExample-Roads_LAttrs LArt="welldefined" />
            </LINEATTR>
            <P C1="39.038" C2="60.315" />
            <P C1="41.200" C2="59.302" />
            <P C1="43.362" C2="60.315" />
            <P C1="44.713" C2="66.268" />
            <P C1="45.794" C2="67.662" />
            <P C1="48.766" C2="67.408" />
            <P C1="53.360" C2="64.115" />
            <P C1="56.197" C2="62.595" />
            <P C1="57.818" C2="63.862" />
            <P C1="58.899" C2="68.928" />
            <P C1="55.927" C2="72.348" />
            <P C1="47.955" C2="75.515" />
            <P C1="42.281" C2="75.388" />
            <P C1="39.308" C2="73.235" />
            <P C1="36.741" C2="69.688" />
            <P C1="35.525" C2="66.268" />
            <P C1="35.661" C2="63.735" />
            <P C1="37.957" C2="61.455" />
            <P C1="39.038" C2="60.315" />
          </POLYLINE>
        </SURFACE>
      </RoadsExample-Roads_LandCover_Geometry>
    </RoadsExample-Roads_LandCover_TID>
  </RoadsExample-Roads_BASKETID>
</DATASECTION>
```
Standards in Action

Implementation Experiences:

• Application experts develop system independent conceptual schemas

• GIS can implement encoding services on an abstract (= application independent) level!

• Transfer format or service (API) need not be developed but is automatically derived from the conceptual application schema by using the encoding rules!
## Standards in Action

<table>
<thead>
<tr>
<th>Phases of standards life cycles</th>
<th>INTERLIS 1</th>
<th>INTERLIS 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>publication of draft</td>
<td>1986</td>
<td>2000</td>
</tr>
<tr>
<td>first implementation and application tests</td>
<td>1986-1990</td>
<td>2000</td>
</tr>
<tr>
<td>review and refinement of draft according to test results</td>
<td>1990-1991</td>
<td>2000-2001</td>
</tr>
<tr>
<td>publication as standard</td>
<td>1991</td>
<td>2001</td>
</tr>
<tr>
<td>Further implementations and applications</td>
<td>1991-2000</td>
<td></td>
</tr>
</tbody>
</table>
Standards in Action

- Experiences
  - Commercial tools for deriving XML out of UML (automatically) are available
  - Commercial GIS which support model-based data transfer are available (examples: ADALIN, ArcInfo, C-Plan, GeoMedia, MapInfo)
  - Commercial software for quality checks of data models and data is available
  - Minimal model can be fixed worldwide; national, regional and local extensions are possible
  - Existing development and tools can be reused
Summary and Outlook

Experiences and Results
Summary and Outlook

Experiences and Results

- Model-based approach is successfully used for data transfer in Switzerland since 1988
- ISO/TC211-based tools are implemented, tested and available
- Testing of concepts and tools
  - necessary for standards’ acceptance
  - lasted about 6 to 12 months
  - leads to minor changes in the standard’s definition, which are essential regarding applicability of the standard
Summary and Outlook

Outlook:

- **Swiss Proposal:**
  - ISO/TC211 documents should be published, tested, and altered according to the test results

- Switzerland will participate actively in the financing and implementation of testing frameworks (example: project CHEETAH)

- Switzerland offers experience with the model-based approach and implemented and working tools

- Switzerland will adapt its national standard to further ISO/TC211 results (INTERLIS 3 will be based on the 19100 International Standards)
Appendix: Contact

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