Implementing INSPIRE and Creating Mashups with FME

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INSPIRE Conference 2018, Antwerp
Workshop Objective

An open forum for discussion of FME use cases, challenges, and successes as related to the implementation of INSPIRE and use of INSPIRE data.
Agenda

Introduction

1. INSPIRE Implementation Using FME
   - Schema, Geometry Transformation & Validation
   - Creating INSPIRE GML & ATOM Feeds
2. Leveraging INSPIRE data using FME
   - Mashing up INSPIRE data & In-House data
   - Connecting Web Services & APIs

FME Enhancements

Resources
What is FME?

Data Integration Made Easy
What is FME?

Integrate data
Transform data
Validate data
Share data
Plus more
FME Bridges the Gap

Proprietary

Open Source

Open Standards
Your INSPIRE Viewer: Data Inspector

Read any GML
Three Ways to use FME

- **FME Desktop**: Author data transformation workflows in a simple GUI.
- **FME Server**: Take FME to the enterprise with enhanced automation.
- **FME Cloud**: Get the benefits of FME Server in a hosted version.
FME & INSPIRE - Life Cycle Support

Evaluation
Data assessment

Publication
WxS, GML, PDF, KML

Assembly
Formats, Joins

Validation
QA, XSD, values

Transformation
schema, geometry

Write
INSPIRE GML
Agenda

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FME Enhancements

Resources
Transforming your data to INSPIRE: Key Challenges

- **Nested**, object model vs relational (GIS)
- **Spatial reference**
- **Complex, multi-geometry types**
- **Data joins** from diverse sources
- **Series / lists**
- **Many presets** (code lists, namespace)
- **Business rules**
Transforming your data to INSPIRE

- **Application schema** based reader / writer
  - Populate required attribute and geometry schema just like other FME formats
  - Complex attributes & geometries
  - Reconcile **relational to object**
- **All annexes** supported (I,II,III)
- **All geometry** models: 2,2.5 & 3D
- Raster, Point Clouds, Coverages
  
  *No need to be an XML expert*
Schema Mapping Tools for INSPIRE

The challenge:

- Map and transform your data and attributes into the INSPIRE schema.
Schema Mapping Tools for INSPIRE

- Feature Type Mapping
- Attribute Name Mapping Transformers
- Attribute Value Mapping Transformers
- SchemaMapper Transformer
- Geometry and Coordinate System Transformations
- INSPIRE Solution Pack from con terra
GML Complex Geometry Support

Transformer
Transformer Name: GeometryPropertySetter

Geometry Part Selection
Geometry XQuery: <All parts>

General Parameters
Property to Set: Geometry Name
Overwrite Existing Properties: No

Traits from Attributes Parameters
Trait Counter Parameters
Geometry Name Parameters
Geometry Name: geometry
Natural Risk Zones: Flood Hazard Areas

1. Read source data [UK EA flood risk areas]
2. Add writer and import feature type
3. Simplify the geometry
4. Reprojection BNG to INSPIRE crs: ETRS89
5. ID generation gml_id, localId, inspire ID
6. Addition of required fields and schema mapping
7. Write INSPIRE GML
8. Validation
Natural Risk Zones: Add Writer

Select 'INSPIRE Themes' Items

- LandUseNomenclature (v4.0)
- MaritimeUnits (v3.0)
- MineralResourcesCore (v3.0)
- MineralResourcesCore (v4.0)
- NaturalRiskZones (v0.0)
- NaturalRiskZonesCore (v3.0)
- NaturalRiskZonesCore (v4.0)
- Network (v3.2)
- Network (v4.0)

Select Feature Types

- GradeSeparatedCrossing
- GridCoverage
- HazardArea
- HazardCoverage
- MaintenanceAuthority
- MarkerPost
- MultiCurveCoverage
- MultiPointCoverage
- MultiSolidCoverage

Filter

Select all
Sorted

OK
Cancel

OK
Cancel
HazardArea data types

- xml_buffer
- xml_geometry
- xml_xml
- xml_boolean
- xml_datetime
- lists{}``
UK EA Flood Data to INSPIRE Natural Hazards: FME Workspace

### AIXM Database to Aerodromes - Schema

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ICAOfield</td>
<td>ICAOValue</td>
<td>DestinationIATAfield</td>
<td>DestinationIATAValue</td>
<td>AirpotField</td>
</tr>
<tr>
<td>2</td>
<td>locationIndicatorICAO</td>
<td>LFMN</td>
<td>DesignatorIATA</td>
<td>NCE</td>
<td>name</td>
</tr>
<tr>
<td>3</td>
<td>locationIndicatorICAO</td>
<td>LFBN</td>
<td>DesignatorIATA</td>
<td>NIT</td>
<td>name</td>
</tr>
<tr>
<td>4</td>
<td>locationIndicatorICAO</td>
<td>LFOJ</td>
<td>DesignatorIATA</td>
<td>ORE</td>
<td>name</td>
</tr>
<tr>
<td>5</td>
<td>locationIndicatorICAO</td>
<td>LFPB</td>
<td>DesignatorIATA</td>
<td>LBG</td>
<td>name</td>
</tr>
</tbody>
</table>
AIXM Database to Aerodromes - Workspace

GML parent child ids relating feature types
Writing Considerations

- Unique IDs
- Feature relationships - parent / child ids
- Code lists
- Geometry names
- Required fields: ids, nilReason, lifespan, nspace
  - inspireId.Identifier.namespace
  - inspireId.Identifier.localId
- Start with a FME knowledge base tutorial
- Iteratively test validation of a few features
INSPIRE Solution Pack for FME

- Transformers incl. transformer help
- INSPIRE code lists
- Tutorials (GML and GDB template)

FME Hub (New!)

- Workspace templates
  - Esri GDB and INSPIRE GML
- Workspace template ATOM Feeds
INSPIRE Solution Pack for FME by con terra
FME Workbench “INSPIRE Template Workspaces”

INSPIRE Data Models (Esri INSPIRE GDB/INSPIRE GML)
INSPIRE Solution Pack Templates

https://hub.safe.com
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FME Enhancements

Resources
FME for Validation

- XML application schema
- Geometry & Attribute
- Business rules
  - ETF WebApp
## Value type test

<table>
<thead>
<tr>
<th>Failure</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type Not in Code List</td>
<td>Administrative unit</td>
</tr>
<tr>
<td>GeographicalName.nameStatus Not in Code List</td>
<td>standardised</td>
</tr>
</tbody>
</table>

## Reference Systems Conformance Class

<table>
<thead>
<tr>
<th>Failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attribute '_coordsys' with value 'EPSG:4258' fails check for in &quot;EPSG:4257&quot;, &quot;EPSG:3035&quot;,&quot;EPSG:3034&quot;</td>
</tr>
</tbody>
</table>


INSPIRE ETF Validator

https://hub.safe.com/transformers/inspire_etf-webapp_validator

This custom transformer lets you run the INSPIRE Executable Test Suites (ETS) on an ETF-webapp instance. By default, the INSPIRE sandbox of the European Commission Joint Research Centre is used. For tests with larger datasets, it is possible (and recommended) to set up your own instance of ETF-WebApp, for instance using the image on Docker Hub.

In the European Union, public entities must harmonise their spatial data and services according to the specifications of the INSPIRE Directive, regulations, and technical guidelines.

This custom transformer was created by GIM, a Safe Software gold partner based in Belgium. The work on this custom transformer was partly funded by the Luxembourgish mapping agency: Administration du Cadastre et de la Topographie and the Flemish Environmental Department: Departement Omgeving.
Troubleshooting Validation Problems

- Administrative Units Thuringia
  - Using the ETF-Validator
  - http://etf-validator.net/
Validation Example Admin Units

- Areas of same level may not overlap
Validation Example Admin Units

Snapping the Administrative Units Boundaries will remove the overlap
Boundaries need to match topological structure of Areas
Validation Example Admin Units

Use TopologyBuilder, AnchoredSnapper and SpatialRelator to detect and fix Boundaries
FME is a powerful tool for all kinds of validation
- Geometry
- Attributes
- Business Rules (ETF Validator)

It can help you to detect and **fix** errors
It is not intended to rebuild or replace the ETF-Validator
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FME Enhancements

Resources
ATOM Feeds

- Alternative way of providing data for INSPIRE
- XML based
Diputació de Barcelona - ATOM Feed

CA08045 - Cartografia de carrers 1:1000 Capolat

Martiç, 20. Març 2019; 01:00:00 | eCartoig@diba.cat (Diputació de Barcelona - Oficina Tècnica de Cartografia i SIG Local - Àrea de Territori i Sostenibilitat)

Cartografia d’adreces i carrers dels municipis de la província de Barcelona a escala 1:1000. La informació es desglossa en dos tipus d’elements geogràfics: eixos de carrer (lines) i portals (punts).

CA08124 - Cartografia de carrers 1:1000 Mollet del Vallés

Martiç, 20. April 2016; 02:00:00 | ajuntament@molletdelvallès.cat (Ajuntament de Mollet del Vallés)

Cartografia d’adreces i carrers dels municipis de la província de Barcelona a escala 1:1000. La informació es desglossa en dos tipus d’elements geogràfics: eixos de carrer (lines) i portals (punts).

CA08001 - Cartografia de carrers 1:1000 Abrera

Doming, 18. Jul 2013; 02:00:00 | ecartoig@diba.cat (Diputació de Barcelona - Oficina Tècnica de Cartografia i SIG Local - Àrea de Territori i Sostenibilitat)

Cartografia d’adreces i carrers dels municipis de la província de Barcelona a escala 1:1000. La informació es desglossa en dos tipus d’elements geogràfics: eixos de carrer (lines) i portals (punts).

CA08124 - Cartografia de carrers 1:1000 Mollet del Vallés (EPSG:4258)

Martiç, 20. April 2016; 02:00:00 | ajuntament@molletdelvallès.cat (Ajuntament de Mollet del Vallés)

CA08124 - Cartografia de carrers 1:1000 Mollet del Vallés (EPSG:25831)

Martiç, 20. April 2016; 02:00:00 | ajuntament@molletdelvallès.cat (Ajuntament de Mollet del Vallés)
Diputació de Barcelona - ATOM Feed

- Provide INSPIRE compliant Address data
- Dataset from more than 300 municipalities
Schema, Validation & ATOM Feeds

Discussion Questions - 15 Minutes

1. Tips & Tricks to Share?
2. How could FME be improved to make this better?
3. How could Safe better support you?
4. Questions?
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FME Enhancements

Resources
Leveraging INSPIRE Data Using FME

- FME Readers (INSPIRE GML, ATOM etc.)
- FME HTTPCaller (any web service)
- Data Inspector
Planning High Voltage Transmission Lines

- Track all crossed cadastral parcels
- Internal information system
  - Tracks location
  - Legal status
  - Usage rights
  - Owners
Planning High Voltage Transmission Lines

- FME Process:
  - Read in-house database
  - Runs against multiple INSPIRE WFS endpoints
  - Updates new or changed parcels
  - Filter by federal state
    - Connect WFS (FeatureReader/HTTPCaller)
  - Automatic updates & notifications (FME Server)
Planning High Voltage Transmission Lines

- Mash-Up of INSPIRE Services & Data:
  - Easy to accomplish with FME
  - Enrich in-house data with spatial information
  - Improve the decision making for planning the power grid
Sentinel & INSPIRE

- Detection of Surface Waters
- Using NDWI (Normalized Difference Water Index)
Analyse Results

- Compare INSPIRE & Sentinel Data processing
  - Hydrography Theme - SurfaceWaters
  - Calculate Areas
  - HTML Report

Report:
Surface Water Body area listed by INSPIRE: 143032557.52 m²

Water body area detected by FME: 46674000 m²

The difference is 96358557.52 m² which equals an approximate detection rate of 32.63 percent.
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FME Enhancements

Resources
Air Quality Data

- German Environment Agency (UBA)
- Air pollution data
  - Particulate matter (PM2.5/10)
  - Carbon monoxide (CO)
  - Ozone (O3)
  - Nitrogen dioxide (NO2)
  - Sulphur dioxide (SO2)
Air Quality Data

- FME & FME Server
  - Load data & automate updates
- Endpoints
  - Stations (INSPIRE Data)
  - Sensor Data (52north SOS)
    - Series REST API
    - SOS endpoint
Connecting Services & APIs

Demo Combining Data for Finland:

1. Finnish Environment Institute (SYKE) ATOM Feed Protected Areas
2. Real-time Air Quality Index
3. European Environment Agency Air Quality Time Series

Visualize air quality in protected areas in Finland in real-time and historically
Connecting Services & APIs

Data Source 1

Finnish Environment Institute (SYKE)

ATOM Feed: Nature conservation and wilderness areas
Connecting Services & APIs

Data Source 2

World’s Pollution: Real-time Air Quality Index

JSON API
Connecting Services & APIs

Data Source 3
European Environment Agency Air Quality Time Series

Air quality time series (E1a & E2a data sets)

These data sets have been exported from EEA’s SQL data base which stores primary validated assessment data and primary up-to-date assessment data (time series, data sets E1a and E2a, respectively) reported by countries and successfully tested by automated QC.

Category
European data

Table definition
- Air Quality annual statistics:
Summary: Leveraging INSPIRE data using FME

- Read INSPIRE Services and combine with your in-house data using FME
- Connect to other services and APIs with FME HTTPCaller
- Mashup!
Mashing Up INSPIRE & In-House Data & Connecting Web Services & APIs

Discussion Questions

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FME Enhancements

Resources
FME: Recent Enhancements

- Fixes & updates for standards and libraries
- OGC
  - WCS Reader 2018.1
  - GML coverage support
  - Ignore schema mode
  - WFS paging
- Workflow
  - Improved performance
  - Partial runs
FME: Recent Enhancements

- XML/JSON/web improvements:
  - tree view
  - web connections / API’s
  - Security: HTTPS / SSL
  - HTTPCaller

- Coverages
  - GML
  - NetCDF4
  - Powerful raster transformers: RasterConvolver, RasterStatisticsCalculator
Key Bug Fixes: INSPIRE GML, XML

- Better default translation result: auto geom name
- New namespace functionality
- Improved multi-geometry, SRS support
- XML fragments - xml_geometry and xml_xml
- Process very large datasets: GMLFeatureComposer plus XMLAppender
Demo: OGC WCS Reader: FME 2019
Coverages: Specialised Observations
GML Coverage Domain and Range Set

<om:result>
  <gmlcov:MultiPointCoverage gml:id="mpcv-1-1">
    <gml:domainSet>
      <gmlcov:SimpleMultiPoint gml:id="mp-1-1"
        srsName="http://xml.fmi.fi/gml/crs/compoundCRS.php?crs=4258&time=unixtime" srsDimension="3">
        <gmlcov:positions>
          60.09726 19.93481 1461844800
          60.09726 19.93481 1461848400
          60.09726 19.93481 1461852000
          60.09726 19.93481 1461855600
          ...
          60.09726 19.93481 1461855600
        </gmlcov:positions>
        <gml:rangeSet>
          <gml:DataBlock>
            <gml:rangeParameters/>
            <gml:doubleOrNilReasonTupleList>
              4.93 8.53 1010.89 75.46 92.0 8.39 -8.12 -2.15 8.47 13.63 2.91 100.0 2.0 11.7 24.9 100.0 0.0 0.0
              6989885.5 -1743936.5 13769114.0 12932554.0
              4.93 8.21 1010.2 75.02 92.0 8.6 -8.33 -2.11 8.6 13.97 3.07 0.0 1.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 15244839.0
              6989885.5 -1743936.5 13769114.0 12932554.0
              4.93 9.23 1010.05 75.47 99.0 9.11 -9.02 -1.27 9.11 14.81 3.59 0.0 1.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 17347900.0
              6989885.5 -1743936.5 13769114.0 12932554.0
          </gml:doubleOrNilReasonTupleList>
        </gml:rangeSet>
      </gmlcov:SimpleMultiPoint>
    </gml:domainSet>
  </gmlcov:MultiPointCoverage>
</om:result>

O&M data from Finnish Meteorological Institute
Coverages: Specialised Observations
Coverages: Specialised Observations
Example FME Partner INSPIRE Solutions

- **con terra** (> 100 implementations across Europe)
- **GIM**, Belgium
- **SWECO**, KMD Denmark, SGU Sweden
- **Spatialworld**, Finland (National Land Survey)
- **ISOGeo, France** SDI Platform
- **GeoData**, Norwegian National GeoPortal
- **AED Sicad** (NAS to INSPIRE conversions)
- **Veremes**, France (INSPIRE writer testing)
- **Metria**, Swedish EPA
- **1-Spatial & Dotted Eyes**, UK
Conclusions, Resources: FME and INSPIRE

FME simplifies INSPIRE* compliance - without any coding:

- **Prepare data** for INSPIRE through data extraction, transformation and schema mapping & con terra’s ISP
- **Write INSPIRE GML** using the INSPIRE GML Writer, with built-in application schemas
- **Validate INSPIRE GML** to ensure compliance with EU standards
- **Share INSPIRE data** using FME Server’s web services
- **Read INSPIRE data and services**
Keys to Success with FME & INSPIRE

- Support domain expert collaboration
- Both consume and produce = better implementations
- Balance between flexibility, complexity and usability
- Integrate with existing workflows
- Rapid prototyping = easy wins early
- Automate and future-proof
Conclusions

INSPIRE Data and Services requirements are comprehensive and complex BUT:

- FME gives you access to whatever data is needed
- FME provides full control over your data model
- INSPIRE writer automatically generates schema from INSPIRE XSDs
- Share it any way that is accessible to anyone
- Integrate and extend existing enterprise systems

*INSPIRE is just the start, not the destination*
Resources

INSPIRE Tutorial:
knowledge.safe.com/articles/1321/eu-inspire-initiative-tutorial.html

Or Google: ‘eu inspire tutorial’

FME Community:
knowledge.safe.com/search.html?f=&q=inspire

Safe.com:
safe.com/inspire

safe.com/webinars  -  INSPIRE  -  Nov 21

Other tutorials: XML, GML, JSON, 3D

Google: INSPIRE FME
Thank You!

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Sören Dupke  
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FME Presentations in Antwerp

- Lessons learned from processing INSPIRE coverage data - Stijn Goedertier
  Tuesday 9:00 (Gorilla 3)

- Creating INSPIRE Data and Services with FME in the Cloud - Benjamin Quest
  Tuesday 9:00 (Gorilla 3)

- Implementing INSPIRE and Creating INSPIRE Mashups with FME: Dean Hintz 14:00 (Okapi 1)