Pushing implementation of European coverage data and services forward

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Elevation, Orthoimagery, Reference systems and Geographical grids
Interoperability is better achieved

...sharing solutions in a collaborative way
What is a Coverage?

• **Coverage:**
  Describe characteristics of real-world phenomena that vary over space and/or time (temperature, elevation, land cover, imagery...)

• **Contains** sets of values, associated to a spatial and/or temporal domain

• **Different types:**
  - Discrete: DiscretePoint, DiscreteGridPoint, DiscreteCurve, DiscreteSurface, DiscreteSolid
  - Continuous: ContinuousQuadrilateral, TIN, ThiessenPolygon, HexagonalGrid, SegmentedCurve
Coverages - Main components

**ISO 19123**

- **Domain Set**: Spatial domain of the coverage – Point locations
- Also considered as a grid
- **Range Set**: The values of the phenomenon
- **Coverage Function**: Defines the correspondence between the domain and the range of the coverage, e.g. the rules assigning the phenomenon values to the grid
- **Range Type**: Describes the characteristics of the range values (type of phenomenon)
- **Metadata**
Coverages - Main components

CIS v1.1

class CIS::AbstractCoverage (as per coverage)

+ id :string  
+ coverageFunction :GML::CoverageFunction [0..1]  
+ envelope :EnvelopeByAxis [0..1]

«Feature Type»
AbstractCoverage

+ id :string  
+ coverageFunction :GML::CoverageFunction [0..1]  
+ envelope :EnvelopeByAxis [0..1]

«Data Type»
Metadata
+ any :any [0..*]

SWE Common :: DataRecord
+ data :DataRecord

«Data Type»
RangeType
+ any :any [0..*]

+domainSet +rangeSet +rangeType +metadata 0..1

«Feature Type»
CoverageByDomainAndRange

+domainSet +rangeSet +rangeType +metadata 0..1

«Data Type»
DomainSet  
structure of values defined by DomainSet

«Data Type»
RangeSet  
structure of values defined by RangeType, multiplicity defined by DomainSet

+interpolationRestriction

«Data Type»
InterpolationRestriction
+ allowedInterpolation :anyURI [0..*]
INSPIRE Coverages

- **INSPIRE** reuses the concept of coverage from **ISO 19123**

  *spatial object that acts as a function to return values from its range for any direct position within its spatial, temporal or spatiotemporal domain [Adapted from ISO 19123]*

- **Components**
  - **Standard coverage components** (Domain Set, Range Set, Coverage Function, Range Type, Metadata)
  - **INSPIRE-specific properties** (i.e. extensions)
Use of INSPIRE Coverages

• Several themes
  - Atmospheric conditions
  - Meteorological geographical features
  - Oceanographic geographical features
  - Energy resources
  - Elevation
  - Natural risk zones
  - Ortoimaginary
  - Land use
  - Land cover
  - Geology
  - Soil

• Elevation & Orthoimagery
  Data shall be provided using mainly the raster data spatial representation type – Coverages.
Generic Conceptual Model
‘Coverage – Domain and range’ schema
Based on ISO 19123

INSPIRE Elevation Model
‘Elevation Grid Coverage’ schema
Generic Conceptual Model

‘Coverage – Domain and range’ schema

Based on ISO 19123

INSPIRE Orthoimagery

INSPIRE Orthoimagery Model

‘Orthoimage Coverage’ schema
Encoding of INSPIRE Coverages (EL)

- **Coverage, except Range Set**
  - GMLCOV: OGC GML Application Schema for Coverages [OGC 09-146r2], namely CIS v1.0

- **Coverage Range Set**
  - **OPTION 1: Multipart representation**
    - 1\textsuperscript{st} Part: GML Part (gmlcov:RectifiedGridCoverage)
    - 2\textsuperscript{nd} Part: Range Set encoded using a well-known binary format (embedded in 1\textsuperscript{st} Part) – TIFF / GeoTIFF (*)
  - **OPTION 2: External file encoding**
    - 1\textsuperscript{st} Part: GML Part (gmlcov:RectifiedGridCoverage)
    - 2\textsuperscript{nd} Part: Range Set, encoded using an external well-known binary format (gml:File) – TIFF / GeoTIFF (*)
  - **OPTION 3: Inline encoding**
    - Range Set is encoded within the XML inline (DataBlock)

(*) Alternatively, the BAG format for Hydrographic bathymetry data
Case 1 - Delivery through Predefined data sets (ATOM)

- The coverage over a certain territory is split in several pieces (e.g. map sheets), for both organizational and efficiency purposes.
- Implemented using concrete, fixed tiling schema.
- Tiling approach and server characteristics have a direct impact on efficiency of delivery.

Case 2 - Delivery through WCS

- The natural response of a WCS GetCoverage request is a coverage.
- Tiling schema independent.
- Highly advisable to limit the maximum volume of data that may be requested in a single query to achieve efficiency.
Main activities related to coverages:

- **Workshop: Transformation of Coverage-Based Data Themes and WCS – Barcelona (ICGC venues), 29-30 September 2015**
  

- **Follow-up Webinar: Coverage Data and Services, 18 January 2016**

- **Workshop: Implementation and potential of INSPIRE coverage data and WCS - INSPIRE Conference Barcelona, 30 September 2016**
  

Summary of conclusions and results:

Implementation issues

- **Terminology**
  - Coverage-related terms: Tiling, Mosaicking, Predefined datasets.
  - Mixing concepts: Grid coverage vs. Geographical grid

- **Coverage encoding**
  - Evolution of standardization: CIS v1.0 (GMLCOV) → CIS v1.1
  - Clarify usage of alternative encodings.

- **Extensions of OGC standard coverages**
  - Extensions are ignored by standard WCS interfaces / may cause errors.

- **How to deal with huge volume of coverage data**
  - Appropriate tuning of download services to achieve efficiency.

- **Unknown potential / Acceptance in certain communities:**
  - Big Data analytics, Data cube technologies.
INSPIRE Coverage extensions

Existing model
INSPIRE Coverage extensions

Existing model

<featureType>
  OrthoimageCoverage
    + inspireId: Identifier
    + domainExtent: EX_Extent [1..*]
    + interpolationType: InterpolationMethodValue = nearestneighbor
      + avoidable
        + footprint: GM_MultiSurface
        + name: CharacterString [0..1]
        + phenomenonTime: TM_Period [0..1]
      + avoidable_lifeCycleInfo
        + beginLifespanVersion: TM_Position
        + endLifespanVersion: TM_Position [0..1]

{domainDimensionIs2}
{originDimensionIs2}
{domainRequiresCRS}
{domainExtentContainsGeographicElement}
{rangeSetValuesAreOfTypeInteger}
{identicalOffsetVectorsWithinOrthoimageAggregation}
{acquisitionTimeRequired}

+ contributingOrthoimageCoverage: 0..*
The thoughts...

- INSPIRE data models were developed at conceptual level (data product specifications).
- May lead to different implementations.
- OGC standard interfaces expect a specific implementation – The one developed by the OGC CIS standards.
- INSPIRE extensions should be avoided.
- Implementers (often not being experts in this area) get confused when trying to implement INSPIRE coverage data.
The needs...

- Map elements in the INSPIRE conceptual models to those foreseen in the OGC CIS standards.

- Minimize the impact of INSPIRE Extensions by moving these elements to a metadata instance included in the coverage metadata hook.

- Avoid the use of complex modelling:
  - Coverage aggregations.
  - Other associations involving the coverage feature types.

- Dissemination / Training activities
New model proposed
New model proposed

- **featureType**
  - ElevationGridCoverage

- **constraints**
  - rangeSetValuesAreOfTypeFloat
  - domainExtentContainsGeographicElement
  - identicalOffsetVectorsWithinElevationCoverageAggregation
  - originDimensionIs2
  - domainRequiresCRS
  - domainDimensionIs2
  - metadataIsOfTypeElevationGridCoverageMetadata

- **dataType**
  - 201709_Proposal::ElevationGridCoverageMetadata
    + inspireId: Identifier
    + propertyType: ElevationPropertyTypeValue
    + surfaceType: SurfaceTypeValue
    + domainExtent: EX_Extent [1..*]
    + contributingElevationGridCoverage: ElevationGridCoverageAggregation [0..*]
    + voidable, lifecycleInfo
      + beginLifespanVersion: DateTime
      + endLifespanVersion: DateTime

- **enumeration**
  - ElevationBaseTypes::
    - ElevationPropertyTypeValue
  - ElevationBaseTypes::
    - SurfaceTypeValue
      - height
      - depth
      - DTM
      - DSM

- **dataType**
  - 201709_Proposal::ElevationGridCoverageAggregation
    + contributingCoverage: Identifier
    + contributingFootprint: GM_MultiSurface

**Draft**
New model proposed
New model proposed

Draft
Alternatives to proceed

A. Amend existing INSPIRE conceptual models for coverage data.
   - Move extensions to the coverage metadata hook.

B. Create new INSPIRE implementation models for coverage data.
   - Aligned with OGC CIS standards.
   - Mapping their elements to those from the INSPIRE conceptual data models.

C. Combination of A & B.
Aspects to be further explored

- **Mapping of identifiers**
  ‘inspireId’ to OGC coverage identifier type (‘NCName’ type).

- **Retrieve coverage data using WCS by filtering through information in the metadata hook**
  XPath search.

- **Combined delivery of coverage data + vector data**
  e.g. Orthoimage coverage + Mosaic elements.

- **Look at new approaches available in CIS v1.1**
  e.g. Coverage partitioning instead of Coverage aggregation.

- **Cross-theme harmonization**
  Harmonise modelling of INSPIRE data models on coverages from different themes (common items).
Conclusions

- **Need to simplify and align INSPIRE conceptual models on coverages to the implementation standard (OGC CIS).**
- **Near future actions:**
  - Online activities in Thematic Cluster #3 – Explain, improve and get consensus on the proposals.
  - Subsequent potential endorsement by INSPIRE MIG.
  - Draft new TG: Guidelines for the implementation and use of coverages in INSPIRE.
  - Provide INSPIRE coverage implementation examples.
CIS v1.1 Coverage partitions
Looking for your participation...

Open platform where implementers can build communities, share experiences, best practices, raise questions and resolve issues...

- Discussion topics
- Uploaded contents
- News
- Implementation activities

JOIN & PARTICIPATE IN
THEMATIC CLUSTER #3

https://themes.jrc.ec.europa.eu/