



# Geospatial Interoperability issues

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## Overview

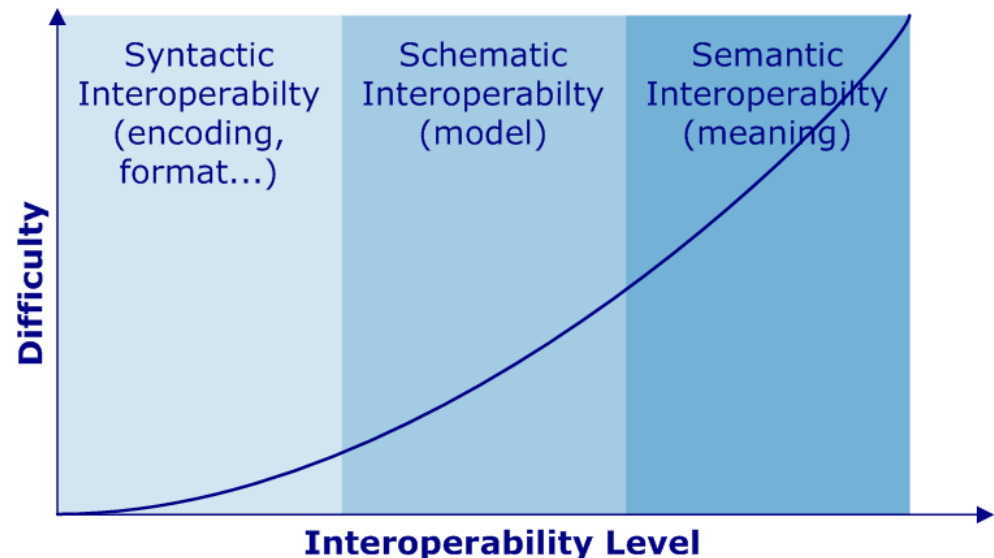
- ▣ Geospatial Data and Service Interoperability Introduction
- ▣ Geodata Harmonisation for Interoperability: The Approach in HUMBOLDT
- ▣ Identified Harmonisation Requirements in HUMBOLDT

## Interoperability – why do we want it?

- ▣ (IT)-Systems and processes are becoming incredibly dynamic in many areas based on decoupling and distribution;
- ▣ Quick reaction to changes or emerging situations is required;
- ▣ Integration effort of diverse distributed resources therefore has to be low to be able to adopt quickly as an organization.
  
- ▣ Enter Interoperability: *“The ability of systems to exchange information automatically”*
- ▣ Organizational, legal interoperability?
- ▣ Here: Focus on technical interoperability of data that is exchanged and services that are used
  
- ▣ Interoperability is the base of the Spatial Data Infrastructure.

## Interoperability – why is it hard to achieve?

- Full interoperability between two systems means that there has to be mutual and complete understanding of many different aspects of interoperability, ranging from identical **encoding, reference systems, units, and classification systems** to a common understanding of the meaning of things (**semantics**);
- Approach towards interoperability varies with each aspect;
- Some aspects are hard to handle in an unambiguous way.



RISE/INSPIRE Data harmonisation/interoperability aspects

- ▣ **Rules for application schemas and feature catalogues**
- ▣ **Coordinate referencing and units**
- ▣ Portrayal Model
- ▣ **Metadata**
- ▣ Data Transfer
- ▣ Data capturing
- ▣ Terminology
- ▣ Spatial and temporal aspects
- ▣ **Multiple representations**
- ▣ Object referencing modeling
- ▣ Identifier Management
- ▣ Maintenance
- ▣ **Consistency**
- ▣ Conformance
- ▣ Reference Model
- ▣ Multi-Linguality
- ▣ Data translation model
- ▣ Registers and registries
- ▣ **Quality**

## Interoperability – General Aspects and Approaches

### □ Syntactic Interoperability:

- Standardization of protocols (http, soap) and of encodings (XML)
- Standardization is done on implementation level and there are only few heterogeneity issues.

### □ Schematic Interoperability:

- Standardization of logical schemas (i.e. the modeling of types and their attributes), e.g. for Geometry (ISO 19107), Feature Catalogues (ISO 19110), Metadata (ISO 19115), Service Descriptions (ISO 19119), Coverages (ISO 19123) or Ontologies (W3C OWL)

### □ Semantic Interoperability:

- Standardization of Application Schemas (i.e. the formal description of Classes of Objects together with their distinguishing properties, such as in the form of an ontology) and usage of Alignments

## Interoperability – Geo-Specific Issues

### □ (Spatial) reference systems:

- Different Spatial Reference Systems are used and sometimes cannot be transformed to another one with sufficient numerical precision;

### □ Multiple Representations and Edge Matching:

- Multiple Data Sets contain representations of the same object, albeit with differing attributes (classified differently, geometry is different due to scale...

### □ Quality:

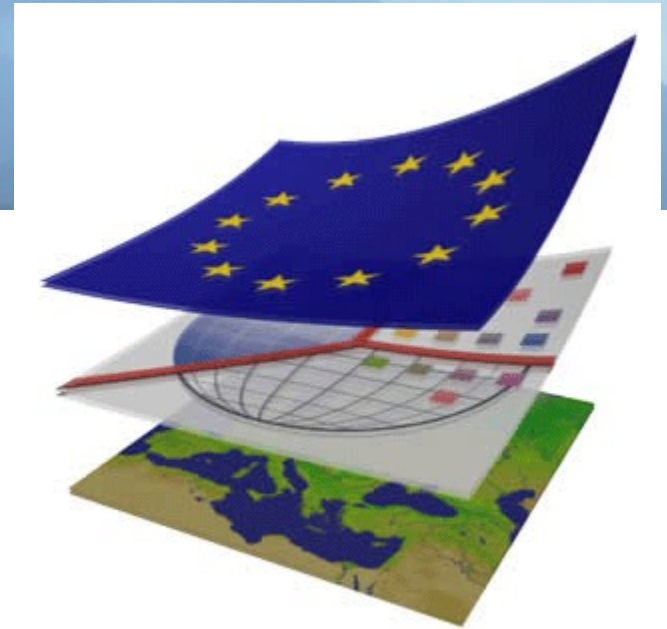
- It is often very hard to determine fitness for a certain use (= Quality) of a spatial data set due to unclear lineage (i.e. which processing was applied, which sensor with which parameters was used to gather the data);

### □ Portrayal, Data Collection...

## Data Harmonisation

- ▣ *“creating the possibility to combine data from heterogeneous sources into integrated, consistent and unambiguous information products, in a way that is of no concern to the end-user”;*
  
- ▣ By performing data harmonisation, interoperability on the level of the structures exchanged (messages) can be achieved. It does not contain processing harmonisation, i.e. an interoperability on the level of what is done with a data set;
  
- ▣ Alternatively to data harmonisation, integration would have to be done on a case-by-case basis with local solutions.

# Harmonisation in the HUMBOLDT Project



## • The HUMBOLDT Project (IP in FP6, 10/2006 to 09/2010)

### ▣ (Some of the) Objectives

- Transsectoral, Translingual, Transborder usage of geoinformation
- Provision of common infrastructure components to glue data producer and consumer transformation needs together
- Support for INSPIRE (tools for data harmonisation) and GMES (theme-specific services in scenarios)

### ▣ User's perspective on the SDI

- From a data-centric view to a usage centric view

## Key Elements of the Approach

### **Application-driven Approach**

- ▣ Identification of user requirements  
(incl. “communication skills”)
- ▣ Proof of concept in different domains

(scenarios)

- ▣ Evaluation as to user requirements

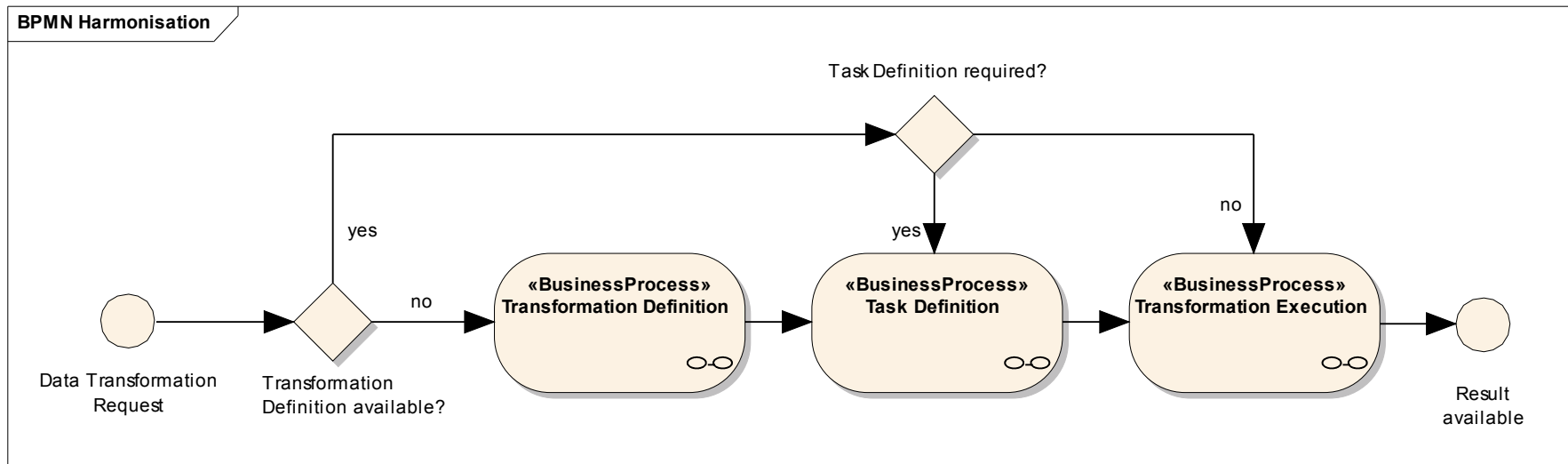
### **Technology-driven Approach**

- ▣ Technical concept, implementation,  
and technical evaluation of the  
harmonisation framework
- ▣ Contributions and use of standards  
(OGC, W3C)

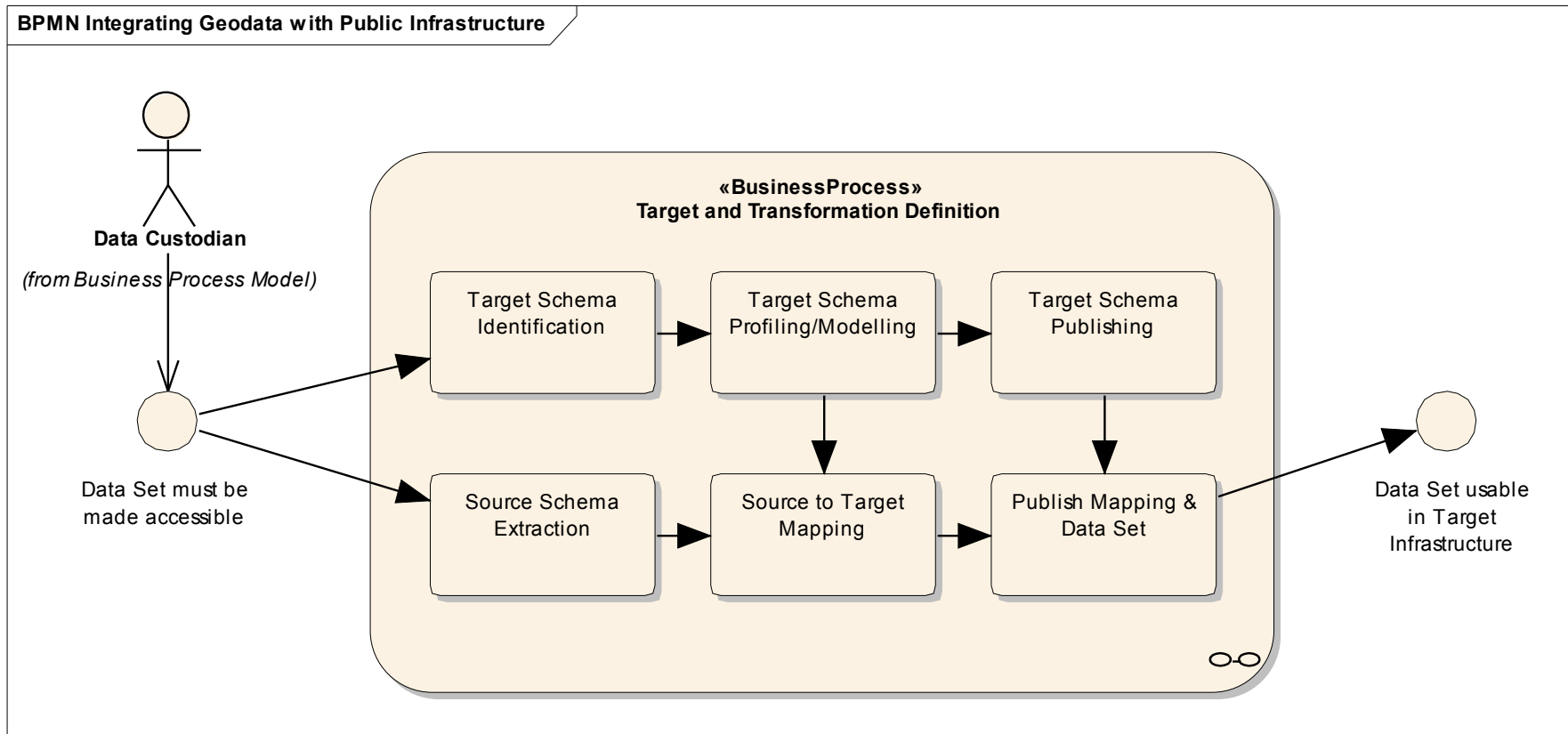
## General Process of Harmonisation/Integration

### Two sides to geospatial integration problems:

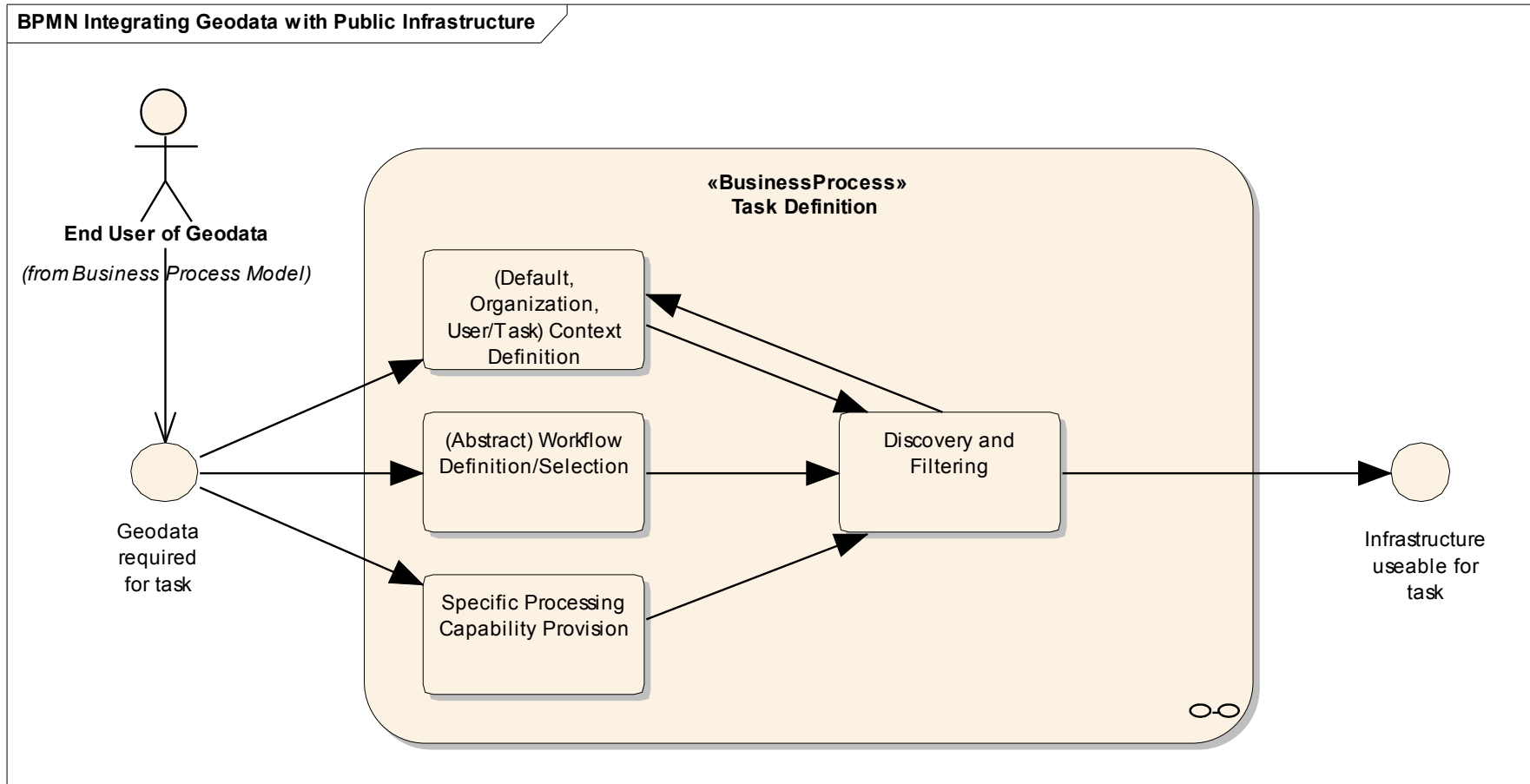
- Integrating local/proprietary data into an infrastructure (like the ESDI based on INSPIRE IR):
- Using public infrastructure data within a local/proprietary environment for specific application domains (like needing a European layer to surround local, domain-specific data)



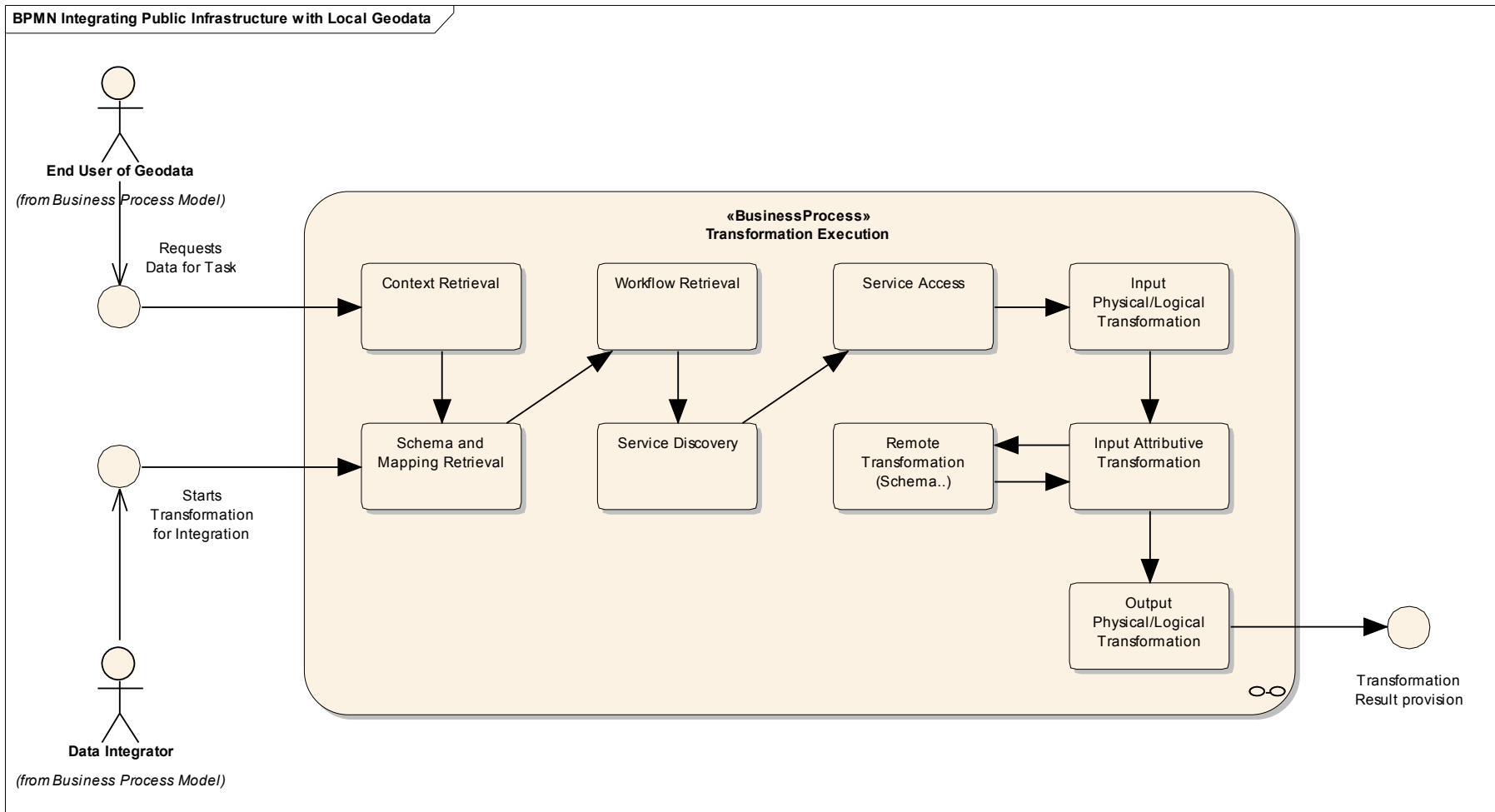
## Source, Target and Transformation Definition



## Task and Process Definition („Product Definition“)



## Transformation Execution (for both integration directions)



## ■ HUMBOLDT Scenario Interoperability Findings

- Scenarios use between ~10 and ~50 different data sets, usually from 3 to 10 providers;
- Between 2 to 3 different **spatial reference systems** are used; transformation between these is still considered a very important issue;
- **Metadata** of the data sets used varies from none to 80+ items from ISO19115, which makes it very hard to assess fitness-for-use; consequently this is the item with the highest scores from the scenarios;
- All scenarios combine discrete and continuous phenomena and consider **consistency** between those as important, as is consistency between **scales**;
- **Portrayal, Multilinguality** and **Processing Functions** are considered to be of medium to lesser importance.

## Summary

### Interoperability:

- ...

### Identifying interoperability issues:

- ...

### Approaching interoperability issues:

- ...

## Outlook and Research Challenges

- ▣ Deeper investigation of the process of geoinformation harmonization itself on a larger basis, to see what patterns emerge between data providers and consumers;
- ▣ Integral quality management in all data processing steps;
- ▣ Handling very different types of data in one contiguous infrastructure;
- ▣ Efficient execution of the process, taking into account optimizations possible by combining multiple steps;
- ▣ Actual execution of conceptual schema translations;
  
- ▣ Development of user guidance concepts for geospatial data alignment processes, including development of languages for geospatial domain experts to describe alignments;
- ▣ Handling of semantic mismatches.

 Thank you for your attention!



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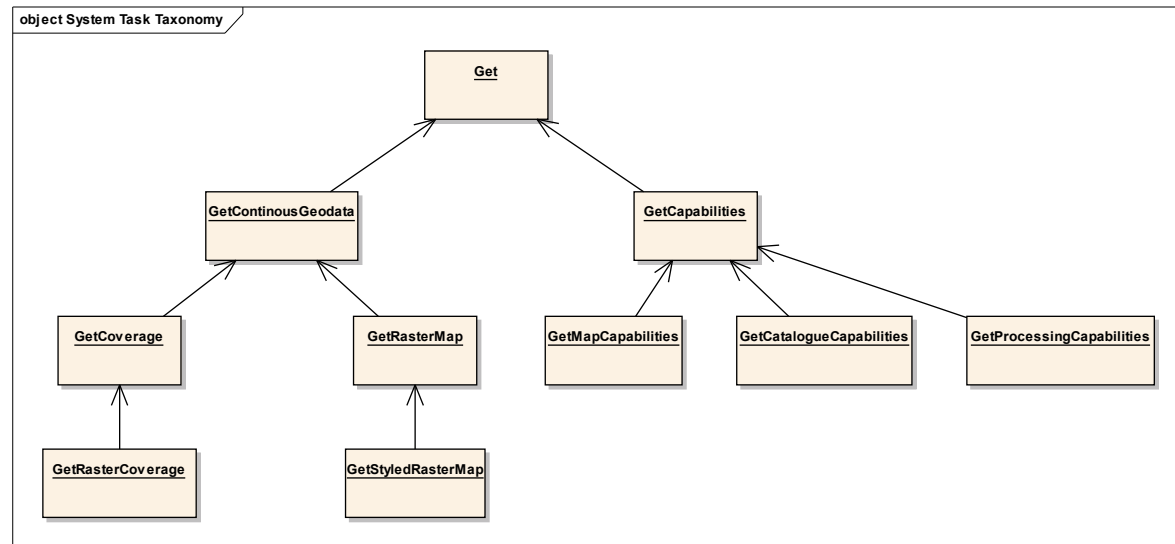
## Task/Context Modelling

▣ **Harmonization process “product definition”:** Usage of a set of constraints on metadata and geodata properties

- ▣ Constraints are extracted from the user’s request as well as from his task, personal, organization and default context

▣ **Task Taxonomy:**

Re-use abstract process definitions for more concrete operations; Selection of concrete Task from



Taxonomy depends on selected interface, operation and parameters

cmp Overview of Components

