
INSPIRE
Infrastructure for Spatial Information in Europe

# Draft Implementing Rules for INSPIRE Transformation Services

Drafting Team “Network Services”

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# 1 Introduction

This document contains the draft proposal for Implementing Rules (IR) on Transformation services as required by the INSPIRE Directive (2007/2/EC). This document is published on the INSPIRE web site [1] on *2009-XX-XX* and will be submitted to the Regulatory Committee as required by the Directive.

The document is organised as follows: Section 1 is introductory to help readers understand the background and requirements without the need to reference other documents. In Section 1.1 general background information is given for the INSPIRE Network Services Implementation Rule development. The Section 1.2 presents the requirements for a Transformation Service as given by the INSPIRE Directive. In Section 1.3 the conceptual background for data transformation is presented, based on the ISO standard 19118:2005 Geographic Information – Encoding. In Section 1.4 three different architecture alternatives for a transformation service implementation are described. The Section 1.5 discusses the possible concrete transformation types that might be implemented, based on the presented abstract service definition.

Section 2 is the core of the implementation rule. Section 2.1 defines the scope of the INSPIRE Transformation Service. Section 2.2 describes on abstract level the operations a Transformation Service is expected to support. Annex A defines the key terms used in the text.

## *1.1 Background*

INSPIRE is a Directive (2007/2/EC) of the European Parliament and of the Council establishing an Infrastructure for Spatial Information in the European Community[2]. The purpose of such an infrastructure is to assist policy-making in relation to policies and activities that may have a direct or indirect impact on the environment. The Directive came into force on the 15th May 2007.

INSPIRE should be based on the infrastructures for spatial information that are created by the Member States. Such infrastructures should be designed to ensure that spatial data are stored, made available and maintained at the most appropriate level; that it is possible to combine spatial data from different sources across the Community in a consistent way and share them between several users and applications; that it is possible for spatial data collected at one level of public authority to be shared between other public authorities; that spatial data are made available under conditions which do not unduly restrict their extensive use; that it is easy to discover available spatial data, to evaluate their suitability for the purpose and to know the conditions applicable to their use.

To achieve these aims, the Directive focuses in particular on five key areas: metadata, the interoperability and harmonisation of spatial data and services for selected themes (as described in Annexes I, II, III of the Directive); network services and technologies; measures on sharing spatial data and services; and coordination and monitoring measures.

Member States are required to bring into force national legislation, regulations, and administrative procedures necessary to comply with the Directive by the 15th May 2009.

To ensure that the spatial data infrastructures of the Member States are compatible and usable in a Community and trans-boundary context, the Directive requires that common Implementing Rules (IRs) are adopted in a number of specific areas. These IRs will be adopted as Commission Regulations or Decisions, and will be binding in their entirety. The Commission is assisted in the process of adopting such rules by a Regulatory Committee composed by representatives of the Member States and

[1] INSPIRE Website: http://www.ec-gis.org/inspire/

[2] The text of the Directive in multiple languages is available at http://eur-lex.europa.eu/JOHtml.do?uri=OJ:L:2007:108:SOM:EN:HTML

chaired by a representative of the Commission (this is known as the Comitology procedure [3]). The Committee was established in June 2007.

The requirements of the Directive in relation to Transformation services are detailed below.

## *1.2 The Directive's Requirements for Transformation services*

In the context of INSPIRE Transformation Services, the following articles from the Directive (PE-CONS 3685/2006) are of major relevance and are quoted here for convenience reasons:

Article 11

*Member States shall establish and operate a network of the following services for the spatial datasets and services for which metadata have been created in accordance with this Directive:*

*…*

- *(d) transformation services, enabling spatial data sets to be transformed with a view to achieving interoperability;*

*…those services shall take into account relevant user requirements and shall be easy to use, available to the public and accessible via the Internet or any other appropriate means of telecommunication.*

Transformation Service is a special case when compared with the other identified service types regarding the obligation of the MSs to provide INSPIRE services. Obviously, it isn't necessary to provide a Transformation Service on the MS level if all the other services are already available in conformance with the related Implementing Rules. This is explicitly stated by Article 7(3) that introduces transformation services as an alternative for data adaptation. Being an auxiliary service type, designed as a mechanism to achieve INSPIRE-compliancy of the other service types, a Transformation Service will usually not be made directly accessible for the general public.

*3. The transformation services referred to in point (d) of paragraph 1 shall be combined with the other services referred to in that paragraph in such a way as to enable all those services to be operated in conformity with the implementing rules provided for in Article 7(1).*

The role of the Transformation Services is to help the other types of services to work in conformance with the related IRs. Consequently, a Transformation Service could potentially be combined with all the INSPIRE content access service types: Discovery, View and Download, to make them interoperable according to the established IRs.

*4. Where public authorities levy charges for the services referred to in points (b), (c) or (e) of Article 11(1), Member States shall ensure that e-commerce services are available. Such services may be covered by disclaimers, click-licences or, where necessary, licences.*

This paragraph seems to suggest, by notably excluding Transformation Service from the list of affected services, that Transformation Services are supposed to be available free of charge.

In Article 7 the role of Transformation Service is clarified in the context of the harmonization of the spatial data sets.

Article 7

*3. Member States shall ensure that all newly collected and extensively restructured spatial data sets and the corresponding spatial data services are available in conformity with the implementing rules referred to in paragraph 1 within two years of their adoption, and that other spatial data sets and services still in use are available in conformity with the implementing rules within seven years of their adoption. Spatial data sets shall be made available in conformity with the implementing rules either*

[3] An explanation of the process for the development and adoption of the Implementing Rules is contained in Section 3 of the Work Programme 2007-09 see
http://inspire.jrc.it/reports/transposition/INSPIRE_IR_WP2007_2009_en.pdf

*through the adaptation of existing spatial data sets or through the transformation services referred to point (d) of Article 11(1).*

In this paragraph the Directive suggests the use of a Transformation Service as an alternative for a permanent adaptation of the existing spatial data sets to the theme-specific INSPIRE data specifications. This implies that Transformation Service has an especially important role in the context of the Download Service, as a tool for achieving data conformity on the service level through transformed virtual data sets.

Article 12

*Member States shall ensure that public authorities are given the technical possibility to link their spatial data sets and services to the network referred to in Article 11(1). This service shall also be made available upon request to third parties whose spatial data sets and services comply with implementing rules laying down obligations with regard, in particular, to metadata, network services and interoperability.*

The service linking functionality referred to in the Article 12 does not apply to the Transformation Service as transformations cannot be aggregated in a straightforward manner, like data content can be.

Article 15(2)

*Member States shall provide access to the services referred to in Article 11(1) through the Inspire geoportal referred to in paragraph 1. Member States may also provide access to those services through their own access points.*

Transformation Service has a particularly important role as a possible value-adding functionality a portal may offer, because Transformation Service is seen as an intermediary function facilitating the communication between a service requestor and a data service provider,

Performance criteria for INSPIRE Network Services are required in Article 16 of the INSPIRE Directive.

Article 16

*Rules for implementation designed to amend non-essential elements of this Chapter by supplementing it, shall be adopted in accordance with the regulatory procedure with scrutiny referred to in Article 22(3), and shall in particular lay down the following :*

(a) *technical specifications for the services referred to in Articles 11 and 12 and minimum performance criteria for those services, taking account of existing reporting requirements and recommendations adopted within the framework of Community environmental legislation, existing e-commerce services and technological progress ;*

## *1.3 Schema Transformation in data interchange*

The basic principle of data transformation in the context of data interchange is presented in the ISO standard 19118:2005 Geographic information – Encoding. According to this standard the data interchange between two disparate systems A and B (see Figure 1) can be based on a commonly agreed application schema (*I*) applied during the data transfer. Both systems involved in the data interchange transaction implement a mapping functionality ($m_{AI}$) that translates the data instances from the internal schema of the system to the common schema and vice versa ($m_{IB}$). After the data set is mapped to the common schema, it is encoded into the data exchange language according to encoding rules defined in the standard. The receiving system carries out the corresponding processes in reverse order.

The Transformation Service specified in this document corresponds to the schema-mapping module $M_{AI}$ depicted in Figure 1. The process depicted in Figure 1 represents a fixed, provider-controlled transformation approach, where the calling application cannot dynamically affect the outcome of the process. The data interchange as presented in ISO 19118 completely ignores query processing and the related schema mapping requirements.

The process in Figure 1 involves two mapping functions, first carried out by the sending system and another by the receiving system. In the context of the discussed Transformation Service, the second transformation is entirely application dependent and thus out of scope.

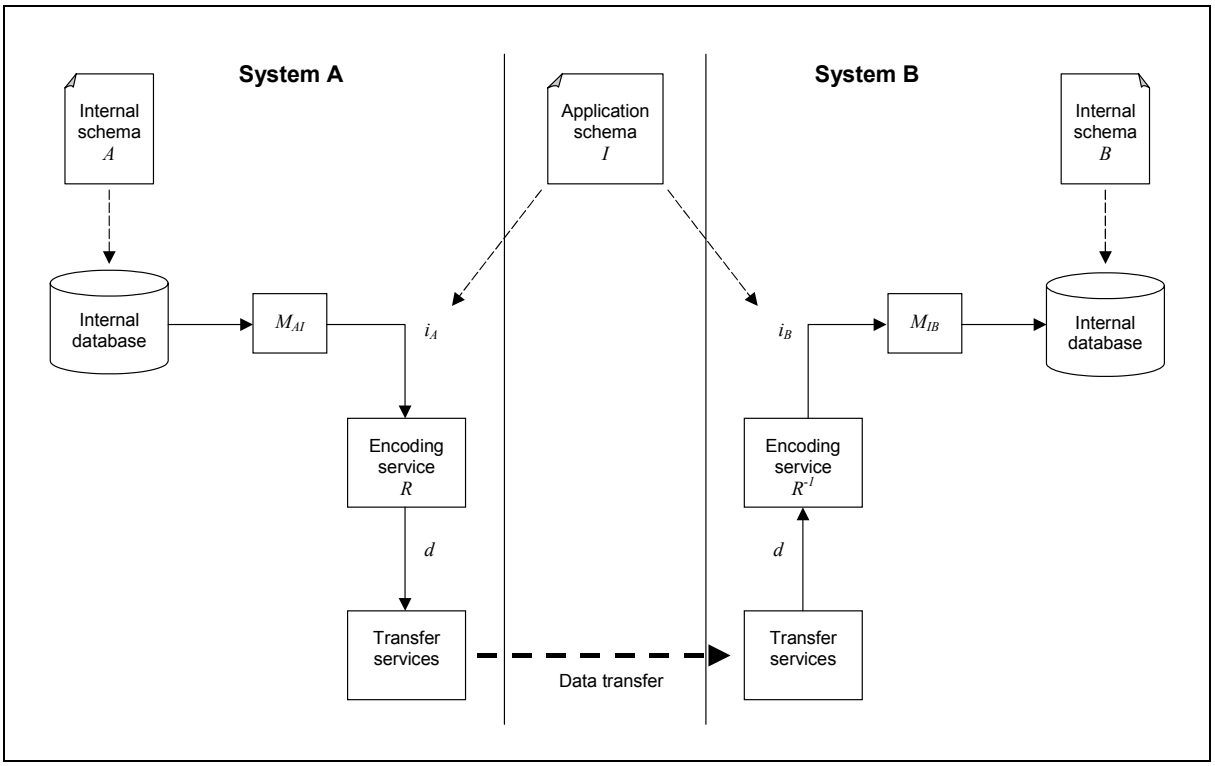


Figure 1. Data interchange between disparate systems, according to ISO 19118 Encoding.

## *1.4 Service architecture*

Due to its nature as an intermediate service between a user application and an INSPIRE content access service (Discovery/View/Download), the architectural design is an important consideration in the context of the transformation service. Transformation functionality can also be incorporated as an integral part of the content service itself. As the functionality is then not exposed to the outside world, there are no standardization requirements involved. Another alternative is to layer the transformation functionality tightly on top of the content access service. In this case the transformation module acts as an opaque proxy or façade for the content access service and thus have to expose to the calling application the access interface of the underlying service.

When the transformation functionality is seen as an independent service node, separate from the content access service it is supporting, it becomes necessary to standardise its access interface. The relationship between the Transformation Service and the related content access service is illustrated in Figure 2.

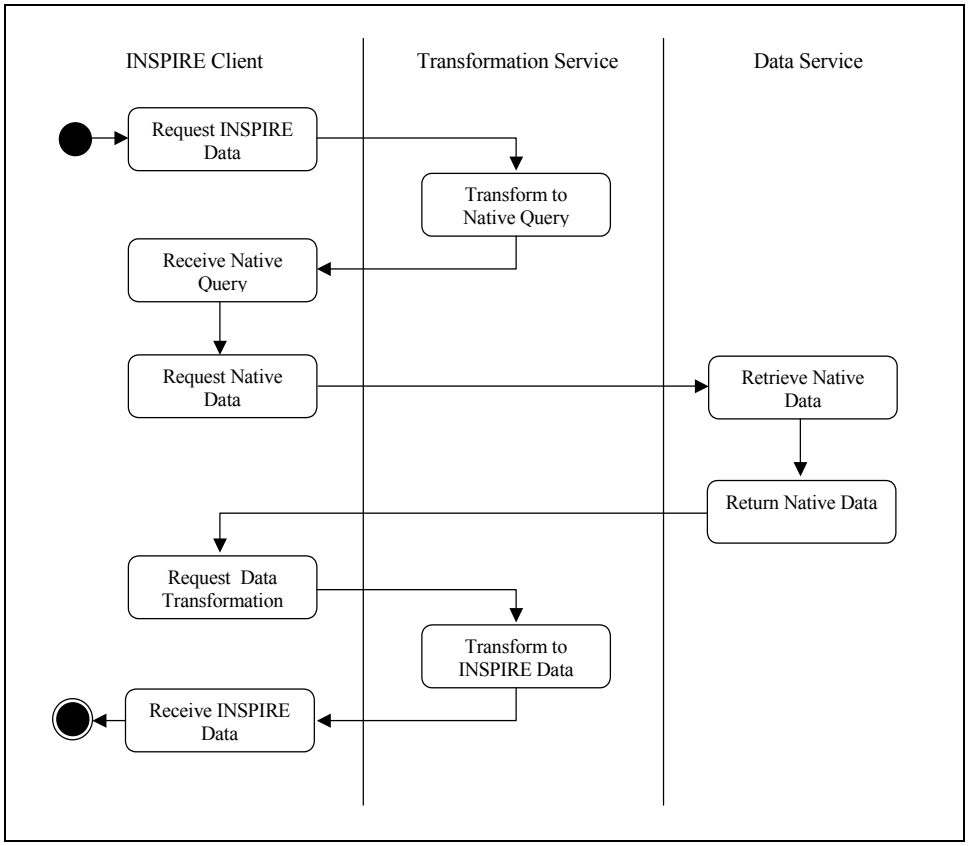


Figure 2. Transformation as an independent service node.

The calling client application is in control of the transformation process. The client has to first request the query transformation and, after the subsequent data access, request the transformation of the resulting data set. The query transformation is needed, if the calling application does not know the native data model. Even if the calling application is not necessarily responsible for configuring the transformation process itself, in any case it has to indicate to the transformation service the source and target models of the transformation.

This architecture supports flexible service orchestration. The best transformation service provider can be selected freely – even separately for query and data transformations. The service chaining can be managed by the calling application or by a dedicated control flow management service on behalf of it. In the INSPIRE context this role is envisioned for the Invoke Service. Transformation Service is visible to the calling application as a specific type of geospatial processing service. Thus, to establish a consistent way for accessing this service in various MSs, a well-defined access interface for the Transformation Service has to be defined on the European level. The following discussion on Transformation Service implementation rules is based on this service arrangement.

## 1.5 *Transformation categories*

The main transformation types that a Transformation Service could perform in the INSPIRE service context include file format transformations, language translations, geometric transformations and schema translations. In future concrete Technical Guidance documents will be compiled for different transformation types, as seen appropriate.

Direct access Download services must be conformant with a standardised service interface specification for interoperability reasons. In this case the format of the output data set typically also becomes standardised. Consequently, format transformation mostly applies to the file based Download Services only.

Language translations are required in most data download transactions in the context of a Pan-European service infrastructure. These translations could be carried out with the help of a preconfigured terminology mapping (established by INSPIRE multi-lingual registers), or – in a more sophisticated case – be based for instance on dynamic ontology-aided semantic matching. Language translations could quite well be incorporated as a component in a more involved schema translation process.

Geometric transformations are typically carried out to achieve a spatial representation appropriate for a certain display scale. These geometric processes could involve simple generalisation operations like line smoothing, area-to-point conversions, area/length –based selections etc. An important subcategory of the geometric transformations is the coordinate system transformation. This transformation type is among the first ones to be considered in a European-wide spatial data service infrastructure.

Schema transformation is mostly concerned with the modifications required to get the data set from its native local application schema into a schema conformant with the European level specifications. Schema transformation could also be taken as a general term encompassing all the above-mentioned categories as its components.

# 2 The Transformation Service Implementing Rules

## *2.1 Transformation Service description*

In the following discussion Transformation Service is defined only on abstract level. Based on this abstract model, various detailed concrete implementations can be specified for different transformation categories and technical frameworks. In this abstract model Transformation Service is approached as an independent geospatial processing service that could be combined with a content service (Discovery/View/Download) to make its data output conformant with established data specifications. Potentially a Transformation Service could also process data queries.

**Name:** INSPIRE Transformation Service

**Description:**

An INSPIRE Transformation Service is a Web service for carrying out data content transformations from native data forms to the INSPIRE-compliant form and vice versa (see Article 11(1) (d), Article 11(3) and Article 7(3)).

The Transformation Service, as presented in the Directive, is an individual, independent spatial processing service. Instead of relying on this kind of transformation service, a data provider can set up the same transformation as an internal function of a content access service (Discovery, View or Download Service). The function can be realized as a batch process resulting in a conforming service database or as an on-the-fly transformation organized on top of a native database. For service performance and robustness reasons this is the recommended way for achieving INSPIRE-compliancy through data transformations. However, these approaches are entirely internal to the data provider and thus out of scope, as seen from Transformation Service definition point of view.

As an independent service type the Transformation Service is most closely related to the direct access Download Service. When connected with a Dataset Download type of Download Service, the Transformation Service carries out only data transformation from a local form into the corresponding INSPIRE-specified common form. However, in the case of a Feature Download Service or a Coverage Download Service, the connected Transformation Service must be required to carry out a two-way transformation, because the data query, expressed according to the common data specifications, must also be transformed (from the common form to the native form). In practical terms this might involve transforming the bounding box of the query sentence from the common coordinate reference system into the system used natively, or transforming other query predicates, expressed in terms of the common schema, to the equivalent expressions in the native schema. The Transformation Operation as-

sumes the availability of data models and mapping allowing the transformation of the input spatial data to be performed unequivocally and with the declared and expected accuracy.

## *2.2 Transformation Service operations*

The operations of the Transformation Service are given in the following table.

| Operation | Description | |
|---|---|---|
| GET SERVICE METADATA | Provides access to service metadata, like information about the supported transformation category, supported transformations, accepted input data types, supported model definition and mapping languages etc. | Mandatory |
| TRANSFORM | Carries out the actual transformation process. The parameters of this operation are detailed in the following table. | Mandatory |
| IS TRANSFORMABLE | By this request the calling application can ascertain, if the given transformation can be performed by the transformation service. Used to avoid unnecessary effort in the case of an impossible transformation. | Mandatory |
| GET TRANSFORMATION | Enables the calling application to retrieve the definition of a specific transformation. This definition can be used as input parameter in a subsequent TRANSFORM – operation. | Optional |
| PUT TRANSFORMATION | Enables the calling application to store a transformation definition into the service. This transformation can be referenced later on in a TRANSFORM -operation. | Optional |

GET SERVICE METADATA operation

Request parameters

| Parameter | Description | |
|---|---|---|
| LANGUAGE | Indicates the natural language requested for the metadata content. Has to be one of the advertised languages. | Optional |

Response parameters

| Parameter | Description | |
|---|---|---|
| SERVICE | General service metadata as defined by INSPIRE metadata IR. | Mandatory |
| OPERATIONS | Operations supported by the service together with theirs address information. | Mandatory |
| LANGUAGES | Natural languages supported by the service. | Optional |

TRANSFORM operation

Request parameters

| Parameter | Description | |
|---|---|---|
| INPUT DATA | Indicates the data set to be transformed. Can be given inline or as a reference to an outside resource, like a content access service. | Mandatory |
| SOURCE MODEL | Specifies the model in which the input data is provided. This is given as an identifier or as a definition. | Conditional, not required if can be determined from the input data. |
| TARGET MODEL | Specifies the model in which the results are expected. This is given as an identifier or as a definition. | Mandatory |
| MODEL MAPPING | Enables the calling application to control in detailed level, how the transformation is to be carried out. | Optional, if a default exists (e.g. a well-known map projection formula). |

Response parameters

| Parameter | Description | |
|---|---|---|
| TRANSFORMED DATA | The result of the transformation. | Mandatory |

IS TRANSFORMABLE operation

Request parameters

IS TRANSFORMABLE request operation has the same parameters than the corresponding TRANSFORM request.

Response parameters

| Parameter | Description | |
|---|---|---|
| RESULT | A Boolean valued result of the transformation test. | Mandatory |

GET TRANSFORMATION

Request parameters

| Parameter | Description | |
|---|---|---|
| IDENTIFIER | Indicates the transformation for which the definition is being request. | Mandatory |

Response parameters

| Parameter | Description | |
|---|---|---|
| TRANSFORMATION | The definition of the requested transformation. | Mandatory |

PUT TRANSFORMATION

Request parameters

| Parameter | Description | |
|---|---|---|
| IDENTIFIER | Indicates to be assigned for the transformation by the service. | Mandatory |
| TRANSFORMATION | Definition of the transformation. | Mandatory |

Response parameters

| Parameter | Description | |
|---|---|---|
| RESULT | Indication whether the PUT TRANSFORMATION operation was successful or not. | Mandatory |

## *2.3 Quality of Service*

**Performance**

The performance requirements for the concrete types of INSPIRE Transformation Services are to be defined in the respective Technical Guidance documents. (As an example, the following value is given for a Coordinate Transformation Service carrying out a simple map projection on an input data set consisting of GML-encoded feature data with only geometric properties included: 1 MB/s).

**Capacity**

Transformation Service is required to support 10 requests at a time.

**Availability**

The probability of the Transformation Service to be up shall be 99% of the time.

# Annex A: Terms and definitions

**data**
Reinterpretable representation of information in a formalised manner suitable for communication, interpretation or processing (ISOIEC23821).

Note: Data can be any form of information. Data may refer to any electronic file, no matter what the format: e.g. a database or binary data, text, images. Everything read and written by a computer can be considered data except for instructions in a program that are executed (software).

**datasets**
Identifiable collection of data (ISO19101).

Note: A dataset may have a hierarchical structure. Theoretically, a dataset may be as small as a single feature or feature attribute contained within a larger dataset. A hardcopy map or chart may be considered a dataset.

**feature**
Abstraction of real-world phenomena. A feature may occur as a type or an instance (ISO 19101).

**interoperability**
The possibility for spatial datasets to be combined, and for services to interact, without repetitive manual intervention, in such a way that the result is coherent and the added value of the datasets and services is enhanced (INSPIRE Directive).

**performance**
Performance is the minimal level by which an objective is considered to be attained. The performance of a web service represents how fast a service request can be completed.

**profile**
Set of one or more base standards or subsets of base standards and, where applicable, the identification of chosen clauses, classes, options and parameters of those base standards that are necessary for accomplishing a particular function (ISO19106).

**resource**
Asset or means that fulfils a requirement. Example: dataset, service, document, person or organisation.

**security**
Quality aspect of the Web service of providing confidentiality and non-repudiation by authenticating the parties involved, encrypting messages, and providing access control.

**service**
Distinct part of the functionality that is provided by an entity through interfaces (ISO19119). In computing terms, a service is an application that provides information and/or functionality to other applications. Services are typically non-human-interactive applications that run on servers and interact with applications via an interface.

Note: This distinct part of the functionality is a computation performed on one side of an interface in response to a request made on the other side of the interface.

Note: Some services may be not available via the network, where data may be on offline media.

**service request**
Operation specified by a service. Example : GETCAPABILITIES, GETMAP, GETFEATURE, GETRECORDS, EXECUTE.

**spatial data**
Any data with a direct or indirect reference to a specific location or geographic area.

**spatial resource**
Asset or means that fulfils a requirement and has a direct or indirect reference to a specific location or geographic area. Example: dataset, dataset series, service.