INSPIRE

Infrastructure for Spatial Information in Europe

INSPIRE Spatial Data Services and services allowing spatial data services to be invoked– Draft Implementing Rules

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Foreword

The INSPIRE directive aims to create a European Union (EU) spatial data infrastructure. The goal of the infrastructure is to enable the sharing of environmental spatial information among public sector organisations and to better facilitate public access to spatial information across Europe.

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 (IR) are adopted in the following 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;

- Measures on sharing spatial data and services;

- Co-ordination and monitoring measures.

The Implementing Rules are adopted as Commission Decisions or Regulations, and are binding in their entirety.

The Commission proposed the development of the spatial data services Implementing Rules to be performed in 2 phases.

In a first exploratory phase the overall framework for the development of the spatial data services implementing rules has been defined and discussed in close cooperation with the INSPIRE stakeholders. Related documents are provided on the INSPIRE website..

In the current second phase an implementing rule is drafted and provided for discussion with the INSPIRE stakeholders.

In parallel there has been work on drafting Implementing Rules for the invoke service.

This document represents the integration of these two efforts. This document will be publicly available as a 'non-paper', as it does not represent an official position of the Commission, and as such cannot be invoked in the context of legal procedures.

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1 Scope

This document specifies implementing rules specifying interoperability and harmonisation requirements applicable for spatial data services as defined in the INSPIRE Directive. It also specifies the implementation rule for the service allowing spatial data services to be invoked – the invoke service.

It provides the basis for the drafting of Implementing Rules according to Article 7 (1) and Article 11 (1) (e) of the INSPIRE Directive [Directive 2007/2/EC].

These Implementing Rules define common arrangements to enable the interoperability of spatial data services. Harmonised and interoperable spatial data services will increase the use of the related spatial data sets by allowing the user to generate derived spatial data sets or derived information more easily. These Implementing Rules have been developed within the general framework of the INSPIRE, and the existing regulations and decisions. In addition, these Implementing Rules have to take into account both existing reference materials, and the current trends within this rapidly evolving field.

1.1 LEGAL CONTEXT

The INSPIRE Directive sets the general scene for the development of the implementing rules laying down technical arrangements for the interoperability and harmonisation of spatial data services and their invocation. It provides a generic definition of spatial data services and their invocation, their relationship with the other elements and lists the fundamental operational requirements on the Member States apart from the compliance with the implementing rules:

- metadata for all existing spatial data services must be created with the attributes and constraints listed in [2]

- spatial data services must be monitored and reported [5]

- spatial data services must be accessible by the Member States to the Community institutions and bodies under harmonised conditions [6]

- there shall be services to allow spatial data services to be invoked [4]

In addition each relevant regulation or decision provides additional elements or information such as:

- a classification of spatial services given in [2]

- the provision of a list of available spatial data services by the Member States [5]

- the provision by the Member States of additional information on the spatial data service when a Community Institution and Body requests access to a spatial data service [6]

This legal background provides important elements for scoping spatial data services and the corresponding implementing rules.

A more detailed analysis of the relevant legal acts is provided in the Annex B of this document.

1.2 EXECUTIVE OVERVIEW

This document introduces a set of definitions that classifies spatial data services into a number of sub-classes. This is done in order to relate different aspects of spatial data services to the appropriate requirements. Network services are seen as a sub-class of spatial data services, and are also classified as invocable spatial data services.

Specific requirements with implications for member states relate only to new developed services relating to harmonised spatial data sets (see Implementing Rule Requirement 9), and to two distinct types of harmonised services, the gazetteer service and the registry service, see chapter 3.4.

Spatial data services are, according to the Directive, the operations which may be performed, by invoking a computer application, on the spatial data contained in spatial data sets and their related metadata. This is a very wide class of services, and this document does not impose any requirement applying to the full class.

INSPIRE only impose requirements for spatial data sets and services relating to the themes in Annex I-III. The metadata regulation already impose the requirement to establish discovery metadata for spatial data services restricted to operating upon data related to Annex I-III and their related metadata. This document does not impose further requirements for this full class of INSPIRE spatial data services.

As a sub-class of the spatial data services, this document defines the set of invocable spatial data services. In short, this is the class where sufficient metadata is given and accessible to allow automatic invocation of the service. The draft implementing rule does not impose any requirement in general for this class.

The next definition of spatial data services compliant to interoperability arrangement narrows further the definition of invocable services by providing additional characteristics. The draft implementing rule requires that Member States comply with these characteristics when they develop new services (from two years after the adoption of the implementing rule) which operate upon harmonised spatial data sets (i.e. spatial data sets in compliance with the regulation as regards interoperability of spatial data sets and services) or their metadata.

Finally, this draft implementing rule requires, where practicable, Member States to harmonise their spatial data services. These implementing rules do not specify criteria for 'where practicable', and this is thus left for the MS to decide.

It also follows from this draft implementing rule that so-called invoke service is not used for other spatial data services invocation. All invocable spatial data services may be invoked outside the services provided by the Member States in the context of INSPIRE based on the information provided by metadata and/or their service interface descriptions.

Invoke service is a service that only provides the necessary metadata to allow automatic invocation of a spatial data service when that metadata exists and is accessible, and thus is discoverable.

1.3   SPATIAL DATA SERVICES IN THE INFRASTRUCTURE

The need and benefits of sharing and accessing spatial data sets in the infrastructure of INSPIRE is apparent, as it largely reflects the way how spatial data infrastructures have been implemented in the last years.

The Network Services (discovery, view, download and transformation) already provide the basic functionality through the abstract specification in the implementing rules and their application programming interfaces (API) in the associated technical guidelines. However applications, if based exclusively on the Network Services, would still concentrate on the sharing and exchange of the spatial data sets. With the direct addition of harmonised spatial data services to the infrastructure the infrastructure will enable the development of significantly richer applications potentially closer for example to the decision making process.

The following list contains examples for what could be considered Spatial Data Services in the Member States.

- The Slovak OGC Web Coverage Service (WCS), hosted by the Slovak Analytical server of SEA 1, is available from the service endpoint http://geo.sazp.sk/cgi-bin/sazp. It provides, amongst others, download access to coverage data on hill shade. It is linked to a spatial data set related to the INSPIRE Directive Annex II "Elevation" spatial data theme.

- The Slovak OGC Web Processing Service, hosted by the Slovak Analytical server of SEA 2[3], provides GRASS visibility (Lines of Sight) analysis, based on elevation information. It is thus linked to the INSPIRE Directive Annex II "Elevation" spatial data theme.

Additional examples are provided in Annex C. The best practices and examples provided by the members of the spatial data services working group available at http://inspire.jrc.ec.europa.eu/index.cfm/pageid/761/list/bestpractice

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[1] http://geo.sazp.sk/#

[2] see http://geo.sazp.sk/#

[3] available from the service endpoint http://geo.sazp.sk/cgi-bin/sazp

1.4 THE INSPIRE IMPLEMENTING RULES

INSPIRE directive requires Implementing Rules (IR) to be produced for the following infrastructure elements:

- Metadata for spatial data sets and services
- Spatial data sets (interoperability of Spatial Data Sets and Services IR)
- Spatial data services (Interoperability of Spatial Data Sets and Services IR)
- Network Services (NS IR)

1.5 NORMATIVE REFERENCES

[ISO 19119]   EN ISO 19119:2005, Geographic information – Services

[ISO 19115]   ISO/DIS 19115-1, Geographic information – Metadata – Part 1: Fundamentals

[ISO 19112]   EN ISO 19112:2003, Geographic information – Spatial referencing by geographic identifiers

[ISO 19118]   EN ISO 19118:2011, Geographic information - encoding

[ISO 19135]   ISO 19135:2005, Geographic information -- Procedures for item registration

1.6 TERMS AND DEFINITIONS

(1) service
distinct part of the functionality that is provided by an entity through **interfaces** [Adapted ISO/IEC TR 14252]

(2) interface
named set of **operations** that characterize the behaviour of an entity [ISO 19119:2005]

(3) operation
specification of a transformation or query that an object may be called to execute [ISO 19119:2005]

(4) spatial data services
means the operations which may be performed, by invoking a computer application, on the spatial data contained in spatial data sets or on the related metadata [Directive 2007/2/EC]

(5) interoperability
capability to communicate, execute programs, or transfer data among various functional units in a manner that requires the user to have little or no knowledge of the unique characteristics of those units [ISO/IEC 2382-1]

(6) gazetteer
directory of instances of a class or classes of features containing some information regarding position [ISO19112:2003]

NOTE The positional information need not be coordinates, but could be descriptive.

(7) geographic identifier
spatial reference in the form of a label or code that identifies a location [ISO19112:2003]

EXAMPLE "Spain" is an example of a country name; "SW1P 3AD" is an example of a postcode.

(8)location
identifiable geographic place [ISO19112:2003]EXAMPLE "Eiffel Tower", "Madrid", "Jämtland"

(9) harmonised spatial data set
Spatial data set conformant with Commission Regulation (EU) No 1089/2010

1.7   SYMBOLS AND ABBREVIATIONS

MS   Member States

IOC TF   Initial Operating Capability Task Force[4]

NCP   National Contact Points

DT   Drafting Team

OGC   Open Geospatial Consortium[5]

SLA   Service Level Agreement

SOAP   Simple Object Access Protocol[6]

WSDL   Web Services Description Language[7]

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[4] http://inspire.jrc.ec.europa.eu/index.cfm/pageid/5/list/ioc

[5] http://www.opengeospatial.org/ogc

[6] http://www.w3.org/TR/soap12

[7] http://www.w3.org/TR/wsdl

1.8 NOTATION OF REQUIREMENTS AND RECOMMENDATIONS

To make it easier to identify the mandatory requirements and the recommendations for spatial data services in the text, they are highlighted and numbered.

IR Requirement X	Requirements that are reflected in the Implementing Rule on interoperability of spatial data sets and services or the Implementing Rule for the Network Services are shown using this style.

SDS Requirement X	Requirements that are not to be included in the Implementing Rule on interoperability of spatial data sets and services or in or the Implementing Rule for the Network Services are shown using this style. These requirements should be included in the associated guidance documentation.

Recommendation X	Recommendations are shown using this style.

2 Introduction

The INSPIRE metadata regulation (1205/2008 (annex D.3)) defines the following spatial data service types:

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3. SPATIAL DATA SERVICE TYPE

3.1. Discovery Service (discovery)

Services making it possible to search for spatial data sets and services on the basis of the content of the corresponding metadata and to display the content of the metadata.

3.2. View Service (view)

Service that makes it possible, as a minimum, to display, navigate, zoom in and out, pan or overlay viewable spatial data sets and to display legend information and any relevant content of metadata.

3.3. Download Service (download)

Service that enables copies of spatial data sets, or parts of such sets, to be downloaded and, where practicable, accessed directly.

3.4. Transformation Service (transformation)

Service that enables spatial data sets to be transformed with a view to achieving interoperability.

3.5. Invoke Spatial Data Service (invoke)

Service that allows defining both the data inputs and data outputs expected by the spatial service and a workflow

or service chain combining multiple services. It also allows defining the external web service interface of the workflow or service chain.

3.6. Other Service (other)

The spatial data service types discovery, view, download, transformation and invoke are dealt with in the network services implementing rules. This document deals with what metadata regulation defines as *other services* in this list so it defines Spatial Data Services that are not Network Services. The metadata regulation also defines a classification of spatial data services based on the taxonomy in EN ISO 19119.

In more detail,

- Discovery: this service makes it possible, based on the resource metadata, to search for the resources spatial data sets and spatial data services in order to discover the ones of potential interest based on user-defined criteria. It could be considered the first step in approaching the infrastructure and its content.
- View: this service makes it possible to display the resource spatial data sets. It provides an additional step towards the assessment of fitness for purpose of a spatial data set based on the visualization of its content.
- Download: this service makes it possible to get copies of spatial data sets or to access their content directly. It could be considered the final step in getting access to copies of spatial data sets or parts of spatial data sets.
- Transformation: taking into account the wide diversity of formats and structures of the resource spatial data sets, it makes it possible to transform them with a view of achieving interoperability (i.e. be compliant with the *data and services Regulation*). The decision to make transformation services available as Network Services is left to each Member State to decide. Alternatively a Member State could provide access to harmonised spatial data sets directly through the network service of type download, while the transformation into the required format and structure is being done behind the scenes (see for example *draft implementing rules* from the NS DT for different scenarios)
- "Invoke": taking into account the potentially wide diversity of interfaces and protocols, invocable services are services that allow access to sufficient service metadata to enable the activation or execution of the spatial data service, thus a invoke service itself does not exist.

It is also important to stress the difference between a spatial data service of spatial data service type "Invoke Spatial Data Service" defined in annex B.3 of EC regulation 1205/2008 and a Network Service allowing spatial data services to be invoked defined in article 11 (1)(e) of Directive 2007/2/EC.
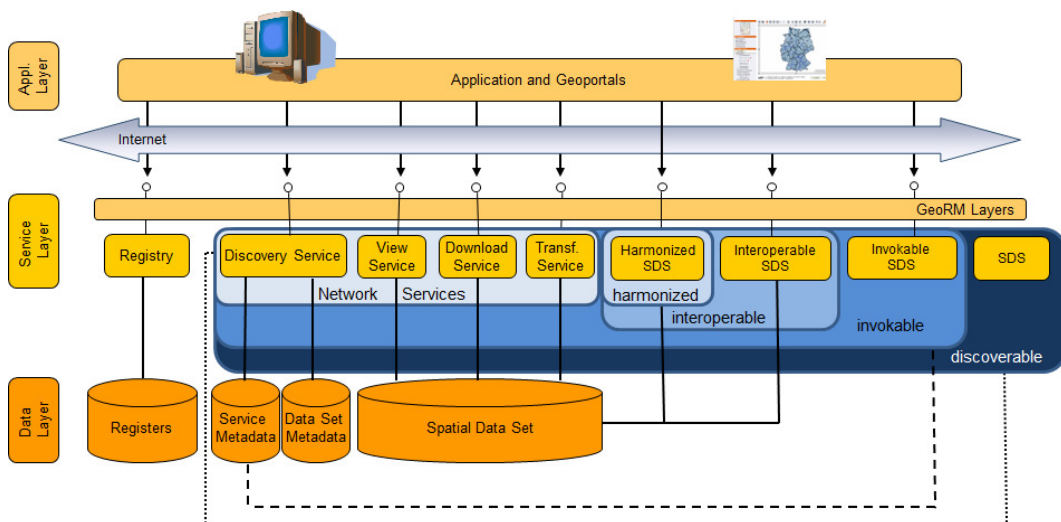

Figure 1 -   Updated INSPIRE Architecture

In addition and where practicable, spatial data services would be harmonised to allow their direct invocation.

3 Spatial data services

Spatial Data Services is a class of services that is broader than the context of the INSPIRE directive. In the context of INSPIRE directive the following criteria must be met for the Spatial Data Services to become an INSPIRE Spatial Data Service:

1. The service is maintained by or on behalf of any of the following:

   (i) a public authority, having been produced or received by a public authority, or being managed or updated by that authority and falling within the scope of its public tasks,

   (ii) a third party to whom the network has been made available in accordance with Article 12 of the INSPIRE Directive.

2. The service is invocable.

3. The service is able to handle spatial data, which relates to one or more of the themes listed in Annex I, II or III of the INSPIRE Directive.

In the context of the INSPIRE implementing rule the broad class of Spatial Data Services is broken down to distinguish the following categories the spatial data services as being of relevance for the INSPIRE implementing rule:

1. spatial data services being discoverable

2. spatial data service being invocable

3. spatial data services being compliant with Interoperability arrangements

4. spatial data services being compliant with harmonisation requirements

Spatial data services are any services operating on spatial data contained in spatial data sets or their related metadata. Given than network services obviously operate on spatial data sets, they can be considered as special subclass of spatial data services (see Figure 2)
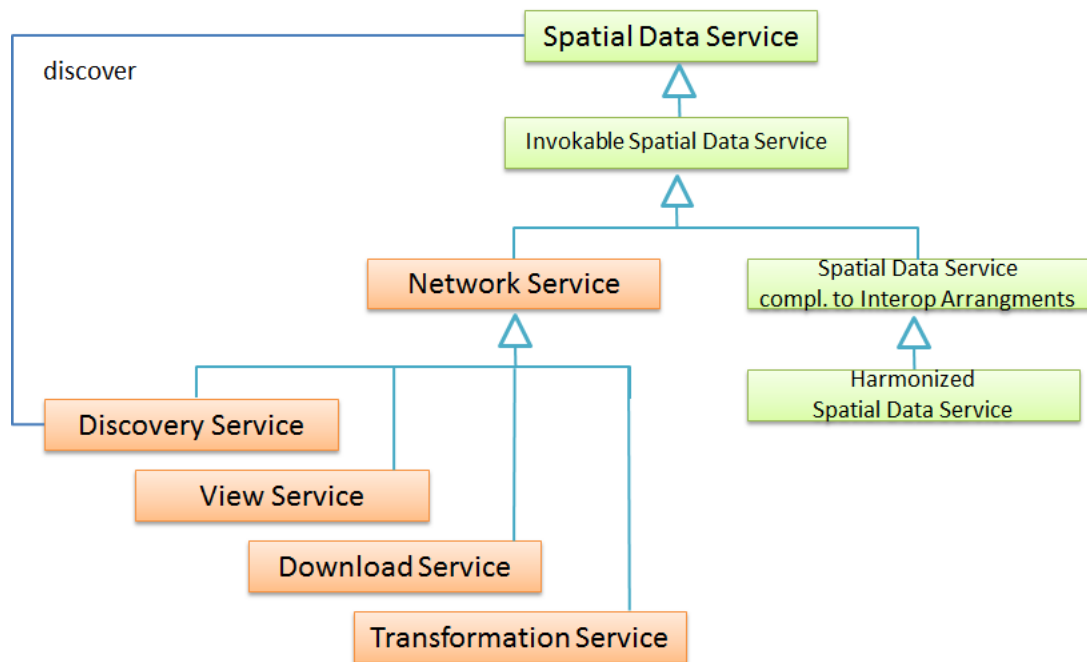
Figure 2 -   The Conceptual model of INSPIRE services (Green Boxed are Spatial Data Services and Orange boxes are the Network Services)

Figure 2 illustrates how the different service types relate to each other. Network services are clearly invocable according to the definition given in this document. According to the INSPIRE Directive, network services apply to both harmonised and non-harmonised spatial data sets, e.g. it is required to establish network services for all data sets for which the metadata regulation applies. Since the definition of interoperability arrangements include the requirement to operate upon harmonised spatial data sets, the network services cannot be a sub-class of neither the class of services compliant with interoperability arrangements nor the class of harmonised spatial data services. Consequently this implementing Rule Does not impose any requirements on INSPIRE Network Services, as these services already fulfil all requirements that are being laid down for invocable Spatial Data Services.

> **SDS Requirement 1** Conceptually Network services are a subset of spatial data services. Network services are also a subset of invocable spatial data services. Network Services fulfil all the requirements set on the invocable services

The INSPIRE Directive requires that Member States shall ensure that metadata are created for the spatial data sets and services corresponding to the themes listed in Annexes I, II and III. Article 7 (4) restricts the scope of the implementing rule to the spatial data services related to those themes. Thus, this will be the domain for the spatial data services in the rest of this document.

IR Requirement 1	The implementing rules are restricted to spatial data services that relate to spatial data sets in themes in Annex I-III, or their related metadata.

From an INSPIRE Implementing Rules applicability point of view, a Spatial Data Service must be *discoverable* as requested by the INSPIRE Directive and the Network Services Regulation with details on the metadata elements provided in the Metadata Regulation. In following ISO 19119 the Metadata Regulation does also define the general categories which apply for spatial data services being made discoverable.

The Metadata Regulation also defines the general categories which apply for spatial data services being made discoverable.

As indicated by figure 2 and 3 (figure 3 exclusively for Spatial Data Services) all further categories defined for spatial data services establish a stepwise more and more precise defined subset of spatial data services:

1. *invocable spatial data services* are services being *discoverable* and services which can be invoked by another service or application (see chapter 3.2)
2. *spatial data services compliant with interoperability arrangements* are services being discoverable, invocable and follow specific requirements for instance on the applied spatial data sets has been laid down in the INSPIRE spatial data services implementing rule (chapter 3.3)
3. *harmonised spatial data services* are discoverable, invocable, compliant with interoperability arrangements and do fulfil additional requirements been laid down in the INSPIRE spatial data services implementing rule (see chapter 3.4)
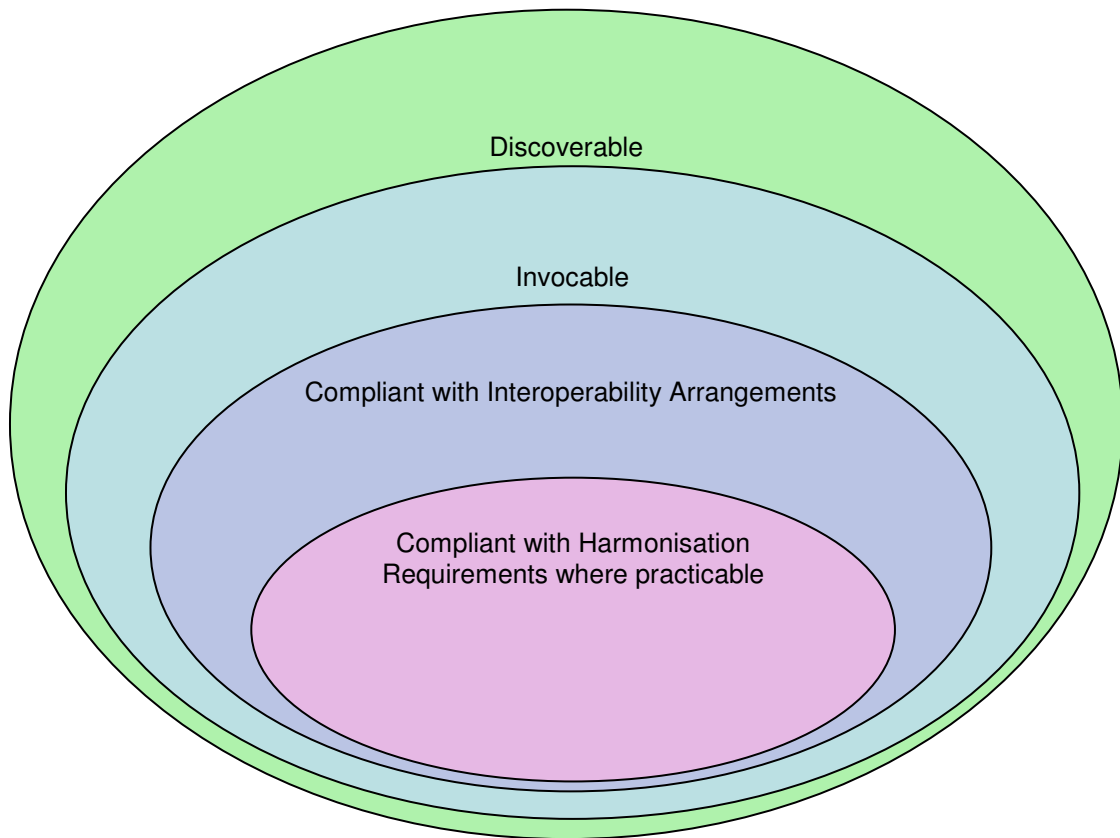
Figure 3 -   INSPIRE Spatial Data Services categories

For what concerns the metadata it is proposed to split the metadata requirements along the categories defined in figure 3 and to identify them as such in the subsequent chapters:

- Discoverable level (already detailed by the Metadata Regulation)

- Invocable level

- Interoperable level

- Harmonised level

IR Requirement 2	All additional metadata elements for Spatial Data Services, not already detailed in Commission Regulation (EC) No 1205/2008, shall be provided in the response of the Discover Metadata operation defined in annex II of Commission Regulation (EC) No 976/2009

3.1 DISCOVERABLE SPATIAL DATA SERVICES (IN THE INSPIRE CONTEXT)

Making spatial data services discoverable does not bring any other obligation than creation of metadata. In particular there are no Quality of Service requirements that have to be met and there is no obligatory quality of service information in the metadata record.

> **Recommendation 1**   There shall be no other requirements applicable to ALL spatial data services than the establishment of discovery metadata.

3.2 INVOCABLE SPATIAL DATA SERVICES

3.2.1 Invocability

A spatial data service is *invocable* if sufficient machine readable metadata exists, is accessible, and is sufficient to allow for its automatic execution (invocation) by another service or an application (e.g. a GeoPortal).

A spatial data service is invocable if the following conditions are satisfied:

1. the spatial data service is discoverable as defined in the Metadata Implementing Rule
2. at least one resource locator (as defined in the Metadata Implementing Rule) for the spatial data service needs to be provided
3. the resource locator defines an activation point and shall be a URL
4. a spatial data service belongs into one of the categories 200, 300, 400, 500, 600, 700, 800 as defined in part D.4 of EC Regulation 1205/2008
5. the spatial data service is conformant to either a standardized specification or well documented specification (e.g. ISO, OGC)
    a. thus respective metadata entry on 'conformance' (as defined in the Metadata Implementing Rule) is set to 'conformant'
    b. The cited specification (see Metadata Implementing Rule) corresponds to the implementing rules adopted under Article 7(1) of Directive 2007/2/EC or of a specification providing all necessary descriptions (human or machine readable) to allow for an automated invocation of the described service
6. the spatial data service has a well-documented and accessible description

Providing these well-documented and accessible description would also require a well-documented set of cited specifications, this could potentially be realised by a specific registry service, thus providing an online **accessible** and citable list of commonly agreed or standardised interface specifications and specific specification profiles there off.

Accessibility in this particular context is proposed to mean providing access to additional documentation and description.

A Geographic Information System or other systems, understood as a set of tools for collecting, processing and storing spatial data should not be considered an invocable spatial data service from the perspective of the relevant Implementing Rules. But any specific functionality included in it and with a well-defined and exposed interface could be an invocable spatial data service.

INSPIRE Network Services do fulfil all these requirements in the following manner:

1. Network Services are discoverable by use of an INSPIRE Discovery Service with the potential exception of the Discovery Service themselves.
2. A resource locator for INSPIRE Network Services is provided in the INSPIRE Metadata for all Network Services except potentially for the discovery services
3. this resource locator includes an activation point that is a URL
4. Network Services service belong into one of the categories 200, 300, 400, 500, 600, 700, 800 as defined in part D.4 of EC Regulation 1205/2008
5. Network Services are conformant to the respective INSPIRE Implementing Rules
6. The respective INSPIRE Implementing Rules and INSPIRE Guidance Documents provide a well-documented and accessible description for INSPIRE network Services
7. The respective INSPIRE Implementing Rules provide well documented and accessible quality of the relevant service characteristics

3.2.2 Invocation Use Cases

When it comes to actually invoke a spatial data service the metadata elements are important at different stages. This chapter describes how the metadata elements listed in the previous section are applied during the evaluation and invocation of a service.

3.2.2.1 Metadata elements for binding

This type of metadata elements is essential to enable a client to get basic invocation information of a given service. Without these elements a further subsequent communication between client and service is impossible.

a. Resource locator: The initial access point to the service.
b. Conformity Reference: Well-known, cited specification of the service instance.

3.2.2.2 Metadata elements for evaluation

This type of metadata elements are essential to evaluate if the service instance meets the client's requirements.

a. Service Category
b. Spatial Reference System
c. Temporal Reference System
d. Conditions applying to access and use
e. Limitations on public access
f. Availability
g. Performance
h. Capacity

In this section it is not important, where the binding and evaluation metadata elements are described, either in the metadata record coming from the catalogue or the service metadata provided by the service instance itself.

3.2.2.3 Scenario 1: Discovery

Prerequisite: The service instance is entirely unknown to the client and needs to be located by using a discovery service.
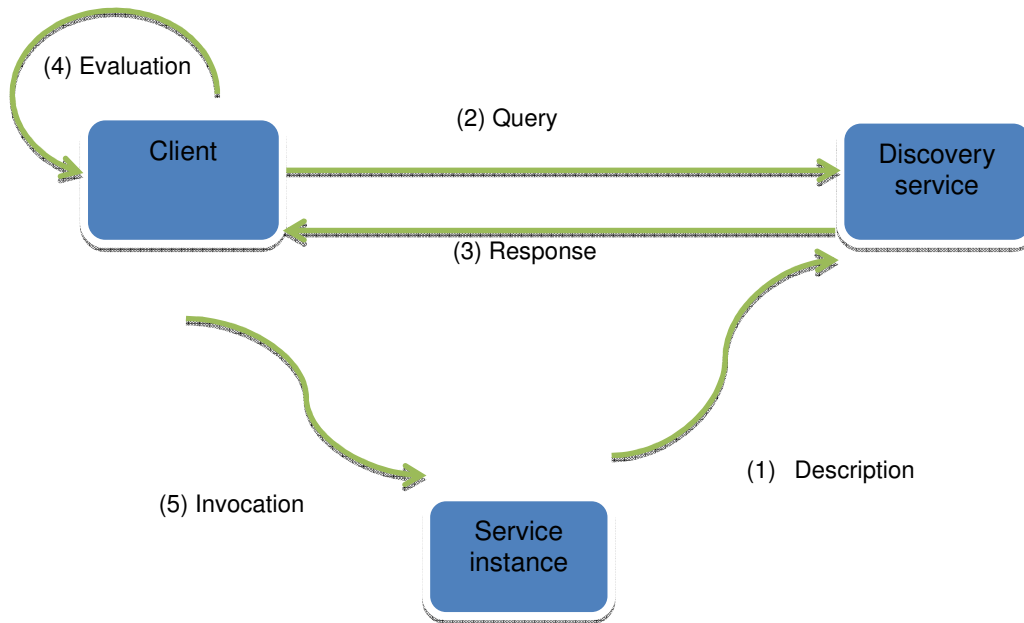
Figure 4 -   Discovery

The workflow is as follows:

(1) Description: a comprehensive metadata description of the target service instance has been published successfully to the discovery service;
(2) Query: a client queries the discovery service based on specific criteria
(3) Response: the catalogue service sends the response with all matching records to the client
(4) Evaluation: The client evaluates the records from (3) against the given requirements
(5) Invocation: The service instance from (1) is invoked.

It is crucial that the metadata elements for binding are provided by the discovery service. This is required to enable the client to request additional service metadata from it (see next chapter).

Metadata elements for evaluation might also be included in the catalogue record of the service, but this is not crucial for the initial response of the discovery service.

3.2.2.4 Scenario 2: Handshake

The second scenario extends the first scenario by describing the concrete interaction (i.e. handshake) between a client and the service instance.

Prerequisites: Metadata elements for binding are known by the client.
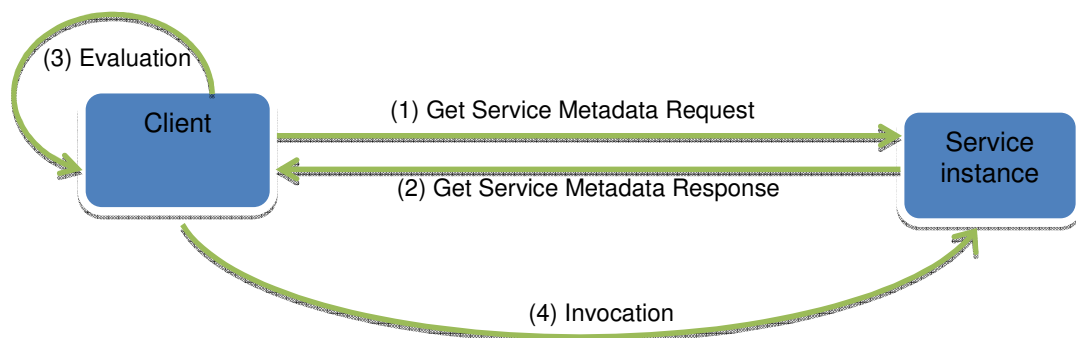
Figure 5 -   Handshake

The workflow is as follows:

(1) Get Service Metadata Request: The client requests he service metadata description form the service instance or from the Discovery Service containing the service metadata, the first case is depicted in Figure 5.

(2) Get Service Metadata Response: the service instance send the document to the client

(3) Evaluation: The client evaluates the metadata description of the service

(4) Invocation: The service instance from (1) is invoked

Metadata elements for evaluation play a major role in terms of using and invoking the service at large.

The Metadata elements that need to be provided for invocable services are defined in the following sections

3.2.3 Resource Locator – invocable level

IR Requirement 3	The Resource locator is an activation point of the service and shall be as defined in section 1.4 of the part B of the Annex of Commission Regulation (EC) No 1205/2008.

A service instance might provide more than one access points. e.g., it is often distinguished between an access point for reading data and an access point one for writing data.

IR Requirement 4	Regarding the service metadata description there shall be only one description per service instance, which then provides information about all possible access points to the service.

Thus, at least one Resource Locator shall be provided.

3.2.4 Specification – invocable level

IR Requirement 5	The specification metadata element shall be as defined in 7.1 of Part A of the Annex of Commission Regulation (ec) No 1205/2008.

IR Requirement 6	This reference is a cited specification that shall correspond to the implementing rules for the spatial data services to be adopted under Article 7(1) of Directive 2007/2/EC or/and to a technical specification providing all necessary descriptions (human or machine readable) to allow for an automated invocation of the described service

.

One or more specification reference shall be provided.

The specification references need to provide sufficient information to actually invoke the service instance and enable the client to use its content. This might include:
- A description of the service interface;
- One or more conformity references for the spatial data being produced by the service instance should be given;
- A WSDL description;
- A schema description or a reference to a schema description for the data being or to be provided.

The DT NS asks reviewers for input on the conformance of SDS, especially regarding the "Specification" metadata element of conformance which requires a well-documented set of cited specifications. Reviewers are invited to bring forward the well documented set of cited specifications, based on existing and/or planned implementations of Spatial Data Services in the MS.

3.3 INTEROPERABILITY ARRANGEMENTS FOR SPATIAL DATA SERVICES

As defined in [ISO 19119], interoperability is the capability to communicate, execute programs, or transfer data among various functional units in a manner that requires the user to have little or no knowledge of the unique characteristics of those units.

Two components X and Y (see Figure 4) can interoperate (are interoperable), if X can send requests R for services to Y, based on a mutual understanding of R by X and Y, and if Y can similarly return mutually understandable responses S to X.
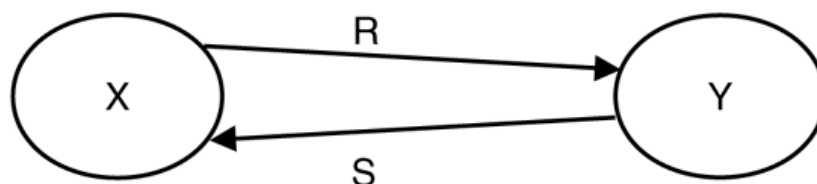
Figure 6 -   Interoperability [ISO 19119]

This means that two interoperable systems can interact jointly to execute tasks. For the geographic domain, the following description of the term "geographic interoperability" is applicable:

In this context (INSPIRE and restricted to spatial data relating to Annex i-III), *spatial interoperability* is the ability of information systems and services to 1) freely exchange in terms of technical communication all kinds of spatial information about the Earth and about

the objects and phenomena on, above, and below the Earth's surface; and 2) cooperatively, over networks, being capable of manipulating such information.

The INSPIRE Directive requires implementing rules to lay down technical arrangement for the interoperability of spatial data services. The user requirements for the interoperability of spatial data services include the ability to reuse spatial data services in new settings (e.g. in another MS), or to orchestrate services to form more complex ones.

Interoperability arrangements consist of set of requirements:

1. data sets that the service relate to
2. coordinate reference systems
3. performance criteria, quality of service
4. metadata

These requirements are described below.

IR Requirement 7	Interoperability arrangements in the INSPIRE context apply only to invocable spatial data services.

3.3.1 Interoperability arrangement – data sets and series

The interoperability arrangements in INSPIRE should go beyond just technical interoperability of the spatial data service itself. The real usefulness and re-usability is connected to the application of spatial data services to harmonised spatial data sets.

IR Requirement 8	Requirements for interoperability arrangements are only mandatory for spatial data services operating upon harmonised data (i.e. spatial data sets conformant to the regulation for IDSS).

3.3.2 Interoperability arrangement – coordinate reference systems

IR Requirement 9	A spatial data service creating or updating a spatial data set and conformant to interoperability arrangement shall provide the spatial data set in at least one of the coordinate reference systems specified in Annex II.1 of the Commission Regulation (EC) No 1089/2010.

3.3.3 Interoperability Arrangement - Temporal reference system

IR Requirement 10	The default temporal reference system referred to in point 5 of part B of the Annex to Commission Regulation (EC) No 1205/2008 shall be

used, unless other temporal reference systems are specified for a specific spatial data theme in Annex I-III.

3.3.4 Interoperability arrangement – performance criteria, quality of service

Spatial data services constitute a very wide class of services and functionalities. It is impossible to set requirements on capacity and response time independent upon these characteristics. From the other hand INSPIRE Directive mandates interoperability of Spatial Data Services and quality of service is considered part of the interoperability, according to Article 3, point 7, interoperability also means that the spatial data services can interact.

Therefore, we restrict the requirements in this field to the availability. In order to comply with the general requirements for the infrastructure defined by INSPIRE, spatial data services should follow the same requirements as for network services, i.e. availability 99% of time.

Since all spatial data services, compliant to interoperability arrangements, are also invocable spatial data services, the rest of quality of service information shall be documented in the respective metadata.

IR Requirement 11	A spatial data service conformant to the interoperability arrangement shall be available 99% of time.

Recommendation 2	No further requirements shall be mandatory for the performance or quality of spatial data services in general.

3.3.5 Interoperability arrangement – metadata

3.3.5.1 Conditions applying to access and use– interoperability arrangements level

IR Requirement 12	It is recognized that the access to the spatial data service may be restricted or may require a proper license. It is therefore required to document restrictions related to the access and use of the spatial data service for both user information purpose and the support of the machine-to-machine semantic interoperability. Adequate information would be provided in the response to the get spatial data service operation request and should be according to the corresponding metadata element defined in EC Regulation 1205/2008

It is important to note that the NS DT understands that the provision of technical requirements and specifications related to access and use restrictions would further ensure the interoperability of spatial services. The NS DT also assesses that it belongs to the wider e-government and digital agenda domains (e.g. eID) and recognizes that no standards are yet mature enough or their implementation is widely endorsed in the European Union. Consequently it proposes these requirements and technical specifications to be outside the scope of this document.

3.3.5.2 Coordinate Reference System – interoperability arrangements level

> **IR Requirement 13** A spatial data service conformant to interoperability arrangement shall provide a description of the coordinate reference system(s) of the spatial data set(s) on which it operates.

If appropriate for the service one or more supported spatial reference systems should be provided.

> **IR Requirement 14** A new metadata element shall be provided to contain the list of supported Coordinate Reference Systems

The value domain of this metadata element is free text. It is worth noting that in December 2011 a proposal for OGC Name Type Specification for Coordinate Reference Systems has been presented for future adoption. Once released (currently planned July 2012) this specification could be used for this new metadata element.

3.3.5.3 Quality of Service: Availability – interoperability arrangements level

> **IR Requirement 15**   A new metadata element shall be provided to document the availability of the Spatial Data Service

The availability describes the percentage of time the service instance is available for immediate consumption

3.3.5.4 Quality of Service: Performance – interoperability arrangements level

> **IR Requirement 16** A new metadata element shall be provided to document the Performance of the Spatial Data Service

The performance of a service instance represents how fast a service request can be completed. In general performance might be expressed by:

1. Throughput, i.e. the number of service requests served in a given time interval.
2. Response time, i.e. the time required to complete a service request
3. Latency, i.e. the round-trip delay (RTD) between sending a request and receiving the response
4. Execution time, i.e. the time taken by a service to process its sequence of activities
5. Transaction time, i.e. the time that passes while the web service is completing one transaction. [8]

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[8] http://inspire.jrc.ec.europa.eu/reports/ImplementingRules/network/Network_Services_Performance_Guidelines_%20v1.0.pdf

3.3.5.5 Quality of Service: Capacity – interoperability arrangements level

> **IR Requirement 17**   A new metadata element shall be provided to document the capacity of the Spatial Data Service

In this context it could be understood as the maximum number of simultaneous requests with the performance criteria defined above.

The capacity shall be expressed as a numerical value.

3.3.6   Requirement on MS

> **IR Requirement 18**   Newly developed spatial data services operating upon harmonised spatial data sets or their related metadata shall be conformant with interoperability arrangements.
>
> This requirement could enter into force two years after the adoption of this implementing rule.

> **IR Requirement 19**   Existing spatial data services updated to operate upon harmonised spatial data sets shall be conformant with interoperability arrangements.
>
> This requirement could enter into force two years after the related spatial data set has been harmonised

3.4   HARMONISED SPATIAL DATA SERVICES

The Directive states that the MS implementation of these harmonised services is **'where practicable'**. The decision to implement them according to the Implementing Rules given here is thus left to the Member States.

One of the major challenges of every infrastructure for spatial information is to ensure harmonised spatial data sets and to provide interoperable services. Harmonisation plays a key role with regard to services invocation and sharing of spatial information from heterogeneous sources.   Taking into consideration the importance of harmonisation for spatial data services the following general spatial data services requirements are defined:

> **IR Requirement 20**   Any harmonised spatial data service shall follow the interoperability arrangements.

Harmonised spatial data services are important components of the infrastructure as the Network Services are. They should therefore be conforming to similar SLA arrangements.

IR Requirement 21 A harmonised spatial data service shall be compliant with minimal QoS criteria defined in the same way as network services, i.e. performance, capacity, and availability. The values will depend upon the character of the type of service.

3.4.1 Harmonisation – encoding

IR Requirement 22 A spatial data service conforming to interoperability arrangement returning spatial objects as part of the output, shall encode those spatial objects according to Article 7 of Commission Regulation (EU) No 1089/2010 of 23 November 2010 implementing Directive 2007/2/EC of the European Parliament and of the Council as regards interoperability of spatial data sets and services.

This means that the rules defined in EN ISO 19118:2011 shall be followed.

IR Requirement 23 The encoding shall follow the concrete specifications for the different themes in Annex I, II and III of the INSPIRE Directive given in the corresponding technical guidelines

3.4.2 Harmonisation – invocation

IR Requirement 24 A spatial data service in this context shall have clearly defined interfaces that enable automatic machine-to-machine communication.

IR Requirement 25 spatial data services shall include a Get Spatial Data Service Metadata operation similar to the Get xx Service Operations described in the Commission Regulation (EC) No 976/2009

4 Annex A   References

[1] Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 establishing an Infrastructure for Spatial Information in the European Community (INSPIRE), OJ L 108, 24.4.2007, p. 1

[2] Commission Regulation (EC) No 1205/2008 of 3 December 2008 implementing Directive 2007/2/EC of the European Parliament and of the Council as regards metadata (Text with EEA relevance) OJ L 326, 4.12.2008, p. 12

[3] Commission Regulation (EU) No 1089/2010 of 23 November 2010 Implementing Directive 2007/2/EC of the European Parliament and of the Council as regards interoperability of spatial data sets and services

[4] Commission Regulation (EU) No 976/2009 of 19 October 2009 implementing Directive 2007/2/EC of the European Parliament and of the Council as regards the Network Services. OJ L 274, 20.10.2009, p. 9

[5] Commission Decision 2009/442/EC   of 5 June 2009 implementing Directive 2007/2/EC of the European Parliament and of the Council as regards monitoring and reporting, OJ L 148, 11.6.2009, p. 18

[6] Commission Regulation (EC) No 268/2010 of 29 March 2010 implementing Directive 2007/2/EC of the European Parliament and of the Council as regards the access to spatial data sets and services by the Member States to the Community institutions and bodies under harmonised conditions

[7] G. Di Matteo, M. Villa "status of Interoperability Arrangements and harmonisation for INSPIRE Spatial Data Services", TXT e-Solutions S.p.A, 10.05.2010 (http://inspire.jrc.ec.europa.eu/documents/Network_Services/STATUS_OF_INTEROPER ABILITY_ARRANGEMENTS.pdf)

[8] Open Geospatial Consortium "OGC Web Services Common Standard" OGC Implementation Standard, Date 2010-0-07, version 2.0.0, Reference Number OGC 06-121r9.

[9] Open Geospatial Consortium "OGC Best Practices Document: Gazetteer Service – Application Profile of the Web Feature Service Implementation Specification" OGC Candidate Implementation Specification, Date 2006-06-05, version 0.9.3, Reference Number OGC 05-035r2.

[10] International Organization for Standardization (ISO) "Geographic information – Location-based services – Multimodal routing and navigation" ISO 19134:2007

[11] M. Villa et al. ¨ INSPIRE Network Services SOAP Framework¨ EUR 23635-2008 (http://inspire.jrc.ec.europa.eu/reports/ImplementingRules/network/INSPIRE_NETWORK _SERVICES_SOAP_Framework.pdf)

[12] INSPIRE Network Services performance Guidelines (http://inspire.jrc.ec.europa.eu/reports/ImplementingRules/network/Network_Services_Per formance_Guidelines_%20v1.0.pdf)

5   ANNEX B   the legal background

This section provides the reader with the legal background for the spatial data services. For each legal act it highlights the most relevant items in the legal acts,

5.1   INSPIRE DIRECTIVE

Recital (3)

[...] Solving these problems requires measures that address exchange, sharing, access and use of interoperable spatial data and spatial data services [...].

Recital (22)

Public authorities need to have smooth access to relevant spatial data sets and services during the execution of their public tasks.

Article 3 (1)

Infrastructure for spatial information' means metadata, spatial data sets and spatial data services; network services and technologies; […].

Article 3 (4)

'spatial data services' means the operations which may be performed, by invoking a computer application, on the spatial data contained in spatial data sets or on the related metadata;

Article 3 (7)

'interoperability' means the possibility for spatial data sets 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 data sets and services is enhanced;

Article 4 (3)

This Directive shall also cover the spatial data services relating to the data contained in the spatial data sets referred to in paragraph 1.

Article 5 (1)

Member States shall ensure that metadata are created for the spatial data sets and services corresponding to the themes listed in Annexes I, II and III, and that those metadata are kept up to date.

Article 6

Member States shall create the metadata referred to in Article 5 in accordance with the following timetable:

not later than two years after the date of adoption of implementing rules in accordance with Article 5(4) in the case of the spatial data sets corresponding to the themes listed in Annexes I and II;

not later than five years after the date of adoption of implementing rules in accordance with Article 5(4) in the case of the spatial data sets corresponding to the themes listed in Annex III.

Article 7 (1)

Implementing rules laying down technical arrangements for the interoperability and, where practicable, harmonisation of spatial data sets and services, designed to amend non-essential elements of this Directive by supplementing it, shall be adopted […].

Article 7 (2)

2. As a basis for developing the implementing rules provided for in paragraph 1, the Commission shall undertake analyses to ensure that the rules are feasible and proportionate in terms of their likely costs and benefits and shall share the results of such analyses with the committee referred to in Article 22(1). Member States shall, on request, provide the Commission with the information necessary to enable it to undertake such analyses.

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.

Article 7 (5)

Representatives of Member States at national, regional and local level as well as other natural or legal persons with an interest in the spatial data concerned by virtue of their role in the infrastructure for spatial information, including users, producers, added value service providers or any coordinating body shall be given the opportunity to participate in preparatory discussions on the content of the implementing rules referred to in paragraph 1, prior to consideration by the Committee referred to in Article 22(1).

Article 11 (1)

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

(…)

(e) services allowing spatial data services to be invoked.

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.

Article 13 (1)

By way of derogation from Article 11(1), Member States may limit public access to spatial data sets and services

Article 17 (1)

Each Member State shall adopt measures for the sharing of spatial data sets and services between its public authorities referred to in point (9)(a) and (b) of Article 3. Those measures shall enable those public authorities to gain access to spatial data sets and services, and to exchange and use those sets and services, for the purposes of public tasks that may have an impact on the environment.

Article 18 (4)

The arrangements for the sharing of spatial data sets and services provided for in paragraphs 1, 2 and 3 shall be open to public authorities referred to in point (9)(a) and (b) of

Article 3 of other Member States and to the institutions and bodies of the Community, for the purposes of public tasks that may have an impact on the environment

Article 18 (8)

Member States shall provide the institutions and bodies of the Community with access to spatial data sets and services in accordance with harmonised conditions.

Article 21 (2)

No later than 15 May 2010 Member States shall send to the Commission a report including summary descriptions of:

(a) how public sector providers and users of spatial data sets and services and intermediary bodies are coordinated, and of the relationship with the third parties and of the organisation of quality assurance;

(…)

5.2 METADATA REGULATION

Article 1

Subject matter

This Regulation sets out the requirements for the creation and maintenance of metadata for spatial data sets, spatial data set series and spatial data services corresponding to the themes listed in Annexes I, II and III to Directive 2007/2/EC.

Article 3

Creation and maintenance of metadata

The metadata describing a spatial data set, a spatial data set series or a spatial data service shall comprise the metadata elements or groups of metadata elements set out in Part B of the Annex and shall be created and maintained in accordance with the rules set out in Parts C and D thereof.

Annex part B 1.6. Coupled resource

If the resource is a spatial data service, this metadata element identifies, where relevant, the target spatial data set(s) of the service through their unique resource identifiers (URI).

Annex part B 2.2. Spatial data service type

This is a classification to assist in the search of available spatial data services. A specific service shall be categorised in only one category.

The value domain of this metadata element is defined in Part D.3.

Annex part B 3. KEYWORD

If the resource is a spatial data service, at least one keyword from Part D.4 shall be provided

Annex part B 8.1. Conditions applying to access and use

This metadata element defines the conditions for access and use of spatial data sets and services, and where applicable, corresponding fees as required by Article 5(2)(b) and Article 11(2)(f) of Directive 2007/2/EC.

Annex Part C Table 2 Metadata for spatial data services

Reference	Metadata element	Multiplicity	Condition
1.1	Resource title	1	
1.2	Resource abstract	1	
1.3	Resource type	1	
1.4	Resource locator	0..*	Mandatory if linkage to the service is available.
1.6	Coupled resource	0..*	Mandatory if linkage to data sets on which the service operates are available.
2.2	Spatial data service type	1	
3	Keyword	1..*	
4.1	Geographic bounding box	0…*	Mandatory for services with an explicit geographic extent.
5	Temporal reference	1..*	
6.2	Spatial resolution	0..*	Mandatory when there is a restriction on the spatial resolution for this service.

Reference	Metadata element	Multiplicity	Condition
7	Conformity	1..*	
8.1	Conditions for access and use	1..*	
8.2	Limitations on public access	1..*	
9	Responsible organization	1..*	
10.1	Metadata point of contact	1..*	
10.2	Metadata date	1	
10.3	Metadata language	1	

5.3 NETWORK SERVICES REGULATION

No additional elements compared to the INSPIRE Directive

5.4 MONITORING AND REPORTING DECISION

Article 2

Common provisions for monitoring and reporting

1. Member States shall establish a list of the spatial data sets and spatial data services corresponding to the themes listed in Annexes I, II and III to Directive 2007/2/EC, grouped by theme and Annex, and of the network services referred to in Article 11(1) of that Directive, grouped by service type.

Article 3

Monitoring of the existence of metadata

1. The following indicators shall be used to measure the existence of metadata for the spatial data sets and services corresponding to the themes listed in Annexes I, II and III to Directive 2007/2/EC:

Article 4

Monitoring of the conformity of metadata

1. The following indicators shall be used to measure the conformity of metadata for spatial data sets and services corresponding to the themes listed in Annexes I, II and III to Directive 2007/2/EC with the implementing rules referred to in Article 5(4) of that Directive […]

2. Member States shall determine, for each spatial data set and service mentioned on the list referred to in Article 2(1) of this Decision, whether the corresponding metadata are in conformity with the implementing rules referred to in Article 5(4) of Directive 2007/2/EC and shall attribute to the data set or service the following values […]

Article 13

Contribution to the functioning and coordination of the infrastructure

The summary description referred to in Article 21(2)(b) of Directive 2007/2/EC shall contain the following:

> (b) A description of the role of the various stakeholders in the development and maintenance of the infrastructure for spatial information, including their role in the coordination of tasks, in the provision of data and metadata, and in the management, development and hosting of services;

> (c) a general description of the main measures taken to facilitate the sharing of spatial data sets and services between public authorities and a description of how sharing has improved as a result;

Article 14

Use of the infrastructure for spatial information

The information on the use of the infrastructure for spatial information referred to in Article 21(2)(c) of Directive 2007/2/EC shall cover the following:

> The use of the spatial data services of the infrastructure for spatial information, taking into account the general and specific indicators;

Article 15

Data sharing arrangements

The summary description referred to in Article 21(2)(d) of Directive 2007/2/EC shall contain the following:

> (c) a list of barriers to the sharing of spatial data sets and services between public authorities and between public authorities and the Community institutions and bodies, as well as a description of the actions which are taken to overcome those barriers.

5.5 DATA SHARING REGULATION

Article 1

Subject matter

This Regulation establishes harmonised conditions of access to spatial data sets and services in accordance with Article 17 of Directive 2007/2/EC.

Article 3

Arrangements

Any arrangements concerning access to spatial data sets and services shall be fully compatible with the requirements of this Regulation.

Article 4

Use of spatial data sets and services

Institutions or bodies of the Community may make spatial data sets or services available to contractors acting on their behalf.

Where spatial data sets and services are made available in accordance with paragraph 1, Community institutions and bodies shall make every possible effort to avoid unauthorised use of spatial data sets and services.

Article 6

Transparency

Where an institution or body of the Community requests the provision of access to a spatial data set or service, the Member States shall also make available, upon request, information for evaluation and use, on the mechanisms for collecting, processing, producing, quality control and obtaining access to the spatial data sets and services, where that additional information is available and it is reasonable to extract and deliver it.

Where requested, offers for the provision of access to spatial data sets and services to the Community institutions and bodies made by Member States shall include the basis for charges and the factors taken into account.

Article 7

Response Times

Member States shall provide access to spatial data sets and services without delay and at the latest within 20 days after receipt of a written request, unless otherwise agreed by mutual agreement between the Member State and the institution or body of the Community.

5.6 INTEROPERABILITY OF SPATIAL DATA SETS AND SERVICES REGULATION

Recital (1):

Directive 2007/2/EC lays down general rules for the establishment of the Infrastructure for Spatial Information in the European Community. Within this infrastructure, Member States are required to make available data sets related to one or several of the Annexes in Directive 2007/2/EC and the corresponding spatial data services in conformity with the technical arrangements for the interoperability and, where practicable, harmonisation of spatial data sets and services.

Article 1

This Regulation sets out the requirements for technical arrangements for the interoperability and, where practicable, harmonisation of spatial data sets and spatial data services corresponding to the themes listed in Annexes I, II and III to Directive 2007/2/EC.

6 Annex C Spatial Data Services Examples

6.1 NORWEGIAN OIL SPILL MODEL AS A SERVICE[9]

Accidental oil releases to the sea may have severe environmental, social and economic consequences. Vital natural resources and human enterprises are at risk.

For oil spill decision making, it is essential to be able to predict the fate and effects of the spilled oil. Fate prediction requires data on the spill (location, time, amount, oil type), the environmental conditions (wind, current), and geography (sea depths, coast line). Effects prediction is based on data about natural resources (e.g. fish populations, protected sites) that may be affected.

Traditionally, oil drift applications have mostly been used to support strategic and tactical decision-making. Typical decisions include "Should the government open region X for exploration?" and "Where should oil booms and chemical dispersants for oil field Y be stored?" Such usage is based on historical input data.

More and more, oil drift models are also used to aid operational decision-making. When an oil spill occurs, oil drift models are tools in the response team's toolbox. Such use of models is quite different as it requires up-to-date forecast data

For the ENVISION project[10], SINTEF[11] MET[12] will provide two web services based on models from SINTEF's oil drift application MEMW/OSCAR:

- *PredictOilDrift* predicts the oil spill concentration in three dimensions plus time (4D);
- *PredictCodEffects* predicts effects for cod populations affected by an oil spill.

These two model services (processing services) are the key elements within ENVISION's oil spill pilot case. Along with appropriate data services (for sea depths, wind, etc), they will constitute Models-as-a-Service (MaaS) for a decision support portal for oil spill response. This portal is intended to support decision-making on an operational level, using up-to-date forecast data.

PredictOilDrift will be implemented by wrapping legacy code while *PredictCodEffects* will be rewritten for ENVISION.

The oil spill pilot will validate the ENVISION approach and verify the ENVISION Infrastructure for adaptive chaining of environmental data and models.

Norwegian Cadastral services

The Norwegian Cadastral system[13] has a multipurpose role and is used for a broad variety of tasks by governmental institutions / the public sector and private companies. Today the most

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[9] http://inspire.jrc.ec.europa.eu/documents/Spatial_Data_Services/BestPractice_OilSpill.pdf

[10] http://www.envision-project.eu/

[11] http://www.sintef.no/

[12] http://www.sintef.no/home/Materials-and-Chemistry/Marine-Environmental-Technology/

important matters are information for the land market and the planning activities and municipal services.

The Norwegian Cadastre is fully computerized as a central database under the control of the Norwegian Mapping and Cadastre Authority.

There are three main units of the Norwegian cadastral system: Information about Parcels, addresses and buildings. The parcel unit comprises property number, area of surface, land use, owners name / identification and postal address, coordinates for a reference point, the cadastral map and cross-reference to buildings and addresses. The address information comprises street name and house number, district codes, reference point and cross-reference. The building information comprises building identification number, type / use, number of floors, numbers and data about each flat (including identifier), reference point and cross-reference.

The Norwegian Mapping Authority has developed a default client using this API, but the API is also exposed to third parties, and several vendors in Norway have developed their own clients for their customers. Most important here, are all the municipalities that are responsible for maintaining the information in the cadastral system.

In the ESDIN project, also a WFS service compliant with INSPIRE Cadastral parcels has been developed[14] (compliant with respect to data content, i.e. validating against the INSPIRE GML schema for CP).

6.2 THESAURUS SERVICE USING REST API[15]

This example describes the usage of GEneral Multilingual Environmental Thesaurus GEMET as a thematic thesaurus.

GEMET is implemented as a pluggable component within a Search function using GEMET webservice API as REST service.

To retrieve data, it is used an approach which sends Requests to the methods, provided by GEMET REST API.

The common used methods for the implementation are as follows:

- getConcept;

- getRelatedConcepts;

- getConceptsMatchingKeyword;

- getAllConceptRelatives.

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[13] http://www.gab.no/

[14] http://youtu.be/J5l4OVivASE

[15] http://inspire.jrc.ec.europa.eu/documents/Spatial_Data_Services/Best%20practice-%20Thesaurus%20REST%20API.pdf

In the implementation user can select language and types keyword in the relative language:

The returned result from the request is in json format and it is parsed and displayed in the user web browser.

Note: AS GEMET REST API is still having some problems with encoding/decoding a parameter for the GET operation, it is developed a conversion function which converts the result to UTF-8 encoding and supports the multilingualism.

The developed thesaurus service is implemented within the eContentplus project "Assessment and strategic development of INSPIRE compliant Geodata-Services for European Soil Data (GS Soil)" and developed by several project partners (Coordination Center PortalU,@ Lower Saxony Ministry of Environment and Climate Protection, Infologica LTD, Wemove digital solutions GmbH, Edisoft S.A.).

6.3   CZECH CADASTER SPATIAL DATA SERVICE[16]

Client can get basic information about parcel owner either by identifying parcel with geographic coordinates or by parcel number. Example for the first:http://nahlizenidokn.cuzk.cz/MapaIdentifikace.aspx?&x=-685937&y=-1050000&maplayers=%208244EA23

NOTE: This should be probably done via OGC WMS GetFeatureInfo service, however, from some reason, this is not possible and so, it is considered as SDS.

6.4   SUPERVISED IMAGE CLASSIFICATION[17]

This SDS is invoked by OGC WPS. Client has to provide following inputs: Vector file with training areas (application/xml), source Coverage to be classified, list of colors assigned to each classified class in the output map. At the output, map in desired format (image/png, image/tiff) is returned.

Web-based client application is also provided, so the user can prepare training areas by interactive editing vector data in the web browser and result of classification can be displayed directly in the map.

Viewshed analysis

Spatial data service returns back calculated map based on input coordinates and observer height. Digital elevation model is stored on the server already. Mapping application which performs viewshed analysis based on digital elevation model and observer coordinates.

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[16]   http://inspire.jrc.ec.europa.eu/documents/Spatial_Data_Services/BestPracticeTemplate-czech-cadaster-institute.pdf

[17]   http://inspire.jrc.ec.europa.eu/documents/Spatial_Data_Services/BestPracticeTemplate-czech-fmi.pdf

Server-side is implemented as OGC WPS process with GRASS GIS in the background. http://geo.sazp.sk/