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INSPIRE-able services

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Abstract

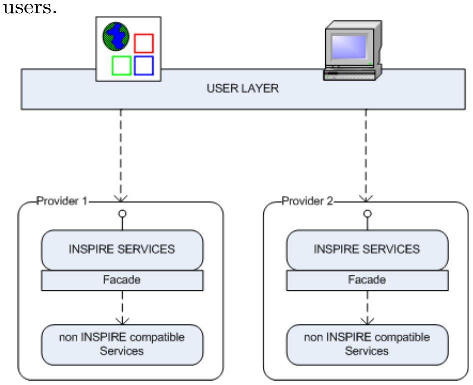
The INSPIRE services network architecture establishes rules for architectural model of the European Spatial Data Infrastructure. Each Member State of the European Union should create new services or adapt existing ones according to the implementing rules derived from the INSPIRE directive. The INSPIRE Drafting Team responsible for services implementing rules has agreed that services should be Web Services using the SOAP protocol as messaging protocol. This paper proposes application of well-known design patterns for adaptation of INSPIRE-unconformable services. However, there are several challenges. There does not exist any methodology to make easy building wrapper services. What is more, the services provided by member states and offered at state level are not restricted by INSPIRE implementation rules. Nevertheless, the application of the INSPIRE implementation rules at levels below the main architecture level (e.g. at member state level) should decrease significantly the complexity of the development of an application architecture based on the INSPIRE infrastructure. Similarly, applying patterns to any external service, including commercial ones, should transform this service into an INSPIRE-able service that would facilitate the creation of any INSPIRE-based application.

Palabras clave: INSPIRE, service pattern, SOA, OGC, SOAP

1 Introduction

The European Union directive named INSPIRE[9] establishes an Infrastructure for Spatial Information in the European Community (INSPIRE). According to the INSPIRE Network Service Architecture Draft[19], there exists a two-level architecture: the Member State (MS) level and the European Union level. Each Member State has to provide the basic services through the Member State access point. This INSPIRE services have to conform with the INSPIRE Network Service Definitions, that means implementation rules defined by INSPIRE Drafting Team. The INSPIRE services will be used by the INSPIRE geo-portal and any application or user that will access them directly at European Union level. However, there does not exist requirements to the services provided by public authorities at the Member State level. To avoid the necessity of the creation of new services by the Member States to fulfil the INSPIRE requirements, the INSPIRE Network Service Architecture Draft has proposed the use of the facade pattern to wrap already existing INSPIRE-unconformable services that will participate in the EU level architecture. Figure 1 presents the facade pattern application as a mediator layer between member states INSPIRE and non INSPIRE services and EU level users.

Figure 1: Facade Service as mediator between member states INSPIRE and non INSPIRE services and EU level users.



The INSPIRE Architecture follows the World Wide Web Consortium (W3C) recommendations of the usage of SOAP as a messaging protocol for web services. This includes WSDL as the service interface description and a possible entry in UDDI directories. The JRC survey about SOAP HTTP binding status[20] concluded in constitution of the definition of a common framework for future INSPIRE services based on SOAP bindings with document-literal wrapped data-encoding (WSDL v2.0).

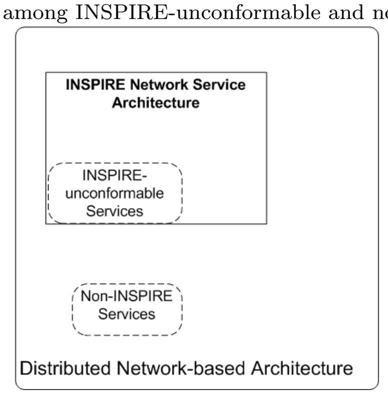
According to the Implementing Rules (IRs), the OGC standards have been identified as the preferred in most cases for implementing new services or adapt existing ones (see table 1). However, other standards may be used as long as they conform with the Implementing Rules. Although existing OGC specifications are not compliant with SOAP protocol[20], OGC teams are working continuously over evaluation of the WSDL/SOAP employment[18, 17, 16]. OGC assessment envisions that the usage of SOAP bindings instead of relying only on HTTP will allow smooth and complete integration in development environments and full integration with Web Services environments (WSDL, UDDI, etc). Moreover, the definition of a common SOAP header allows INSPIRE services to support requirements from “horizontal services“ (e-commerce, geoRM).

Table 1: INSPIRE Implementing Rules recommendations.

Service Type	**OGC Standard recommendation**
View Service	OGC:WMS
Discovery Service	OGC:CSW
Downloads Service	OGC:WFS, OGC:WCS
Transformation Service	OGC:WCTS
Invoke Spatial Data Service	OGC:WPS

The applications based on the INSPIRE architecture may need to use services from MS level that are INSPIRE-unconformable. The term *INSPIRE-unconformable services* means those services that are provided by any public authority but do not satisfy the IRs due to usage of different interfaces or being a legacy systems. Integration of such services will impose development of ad-hoc adapters. Similarly, ad-hoc adapters will be required in case of the *non-INSPIRE services*, the external services, in the sense of services outside the INSPIRE Service Network Architecture, for example a commercial service (see Figure 2). The well-known patterns permit building up a mediator layer between the INSPIRE Service Bus and non-INSPIRE and INSPIRE-unconformable services. This approach promises a significant decrease in the integration costs.

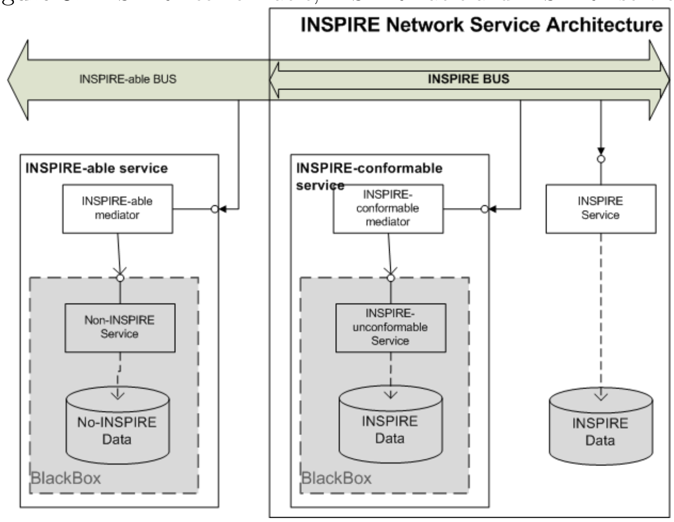
Figure 2: Relation among INSPIRE-unconformable and non-INSPIRE services.



In this paper adapted INSPIRE-unconformable services will be named the *INSPIRE-conformable service*. The mediator service required for the adaptation will be named *INSPIRE-conformable mediator*. In case of non-INSPIRE services the result service will be referred in this paper as *INSPIRE-able service* and its mediator service *NSPIRE-able mediator* (see Figure 3).

This paper is organized as follows. The first section presents the state of art in distributed network-based architecture for the Web technology platform. The second section briefly describes current tendencies within Spatial Web Services. Next, the service pattern approach to adopt services is presented. In the forth section the methodology is presented with practical case of the GoogleGeocoder Service. Finally, the conclusions and future work are presented.

Figure 3: INSPIRE-conformable, INSPIRE-able and INSPIRE services.



2 State of Art

INSPIRE proposes a distributed network-based architecture for interoperable applications dealing with spatial data and realized on the Web technology platform. Currently, there exists two principal architectural design patterns that provide conceptual methodology for distributed network-based systems: *Resource Oriented Architecture* (ROA) and *Service Oriented Architecture* (SOA). Both of them define the interaction mechanisms and interface to access the components of distributed architecture through the network. ROA is focused on distributed resources and SOA is focused on distributed services. Identify a pure SOA-based application is quite difficult because the majority of services accessible via Web that identifies themselves as SOA-based are classified by some authors into (1) “Big“ Web Services[13] based on the SOA paradigm and (2) RESTful Web Services[6, 14], sometimes loosely, based on the ROA paradigm.

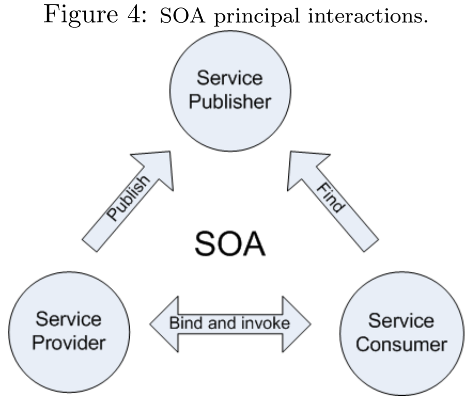
2.1 ROA

The Resource Oriented Architecture (ROA) emerged first as the Representational State Transfer (REST) architecture style, an architectural stylefor the Web presented in doctoral dissertation of Fielding[6]. This is an idealized model of interactions within the World Wide Web which is treated as a world-size distributed hypermedia system. The fundamental elements of this approach[7] are the concept of resource and stateless interactions grounded on the transfer of resource representation.

2.2 SOA

An alternative for the ROA paradigm is the Service Oriented Architecture (SOA). SOA is the core element of the Service-Oriented Computing (SOC)[5]. SOC is a computing paradigm[12] that represents a new generation of distributed systems and promises development cost reduction, also in heterogeneous environment. The broad use of terms "service-oriented architecture" and "SOA" in media and vendor marketing literature has resulted in misunderstanding SOA as synonymous of service-oriented computing platform. According to the platform-independent definition of Thomas Erl, SOA is "*a term that represents a model in which automation logic is decomposed into smaller, distinct units of logic*"[4]. These units of logic are encapsulated in form of reusable services whose functionality is provided via interfaces[1]. These services reflect the "service-oriented" design paradigm where each new application is based on the composition of granulated services. Thus, SOA is designed to support the implementation of service and service composition, and provides mechanism for service publishing, discovering and invocation over the network through their interfaces (see Figure 4). The main principles of SOA are loose-coupling, protocol independence and the use of standards.

Figure 4: SOA principal interactions.



2.3 Web as the Global SOA

Web principles such as distribution, openness, interoperability or user-orientation contribute in settling the Web Services platform as the most popular technology platform that implements the SOA paradigm nowadays. Web Services platform is characterized by its diversity. There exist numerous standards and specifications supported by different vendors and communities. Two basic integration styles exist within the Web services platform. They are the message-base and RPC-based style. The message-based style might be divided into two generations depending of standards and specifications used: First-Generation Web Services Platform and Second-Generation Web Services Platform[5]. The first one is based on WSDL, SOAP, UDDI and WS-I Basic Profile. The second generation platform involves WS-* and intends fulfil the need of commerce QoS for message-level security, cross-service transactions, and reliable messaging. This division does include only the SOAP-based Web services, the so-called *Big* Web Services [13].

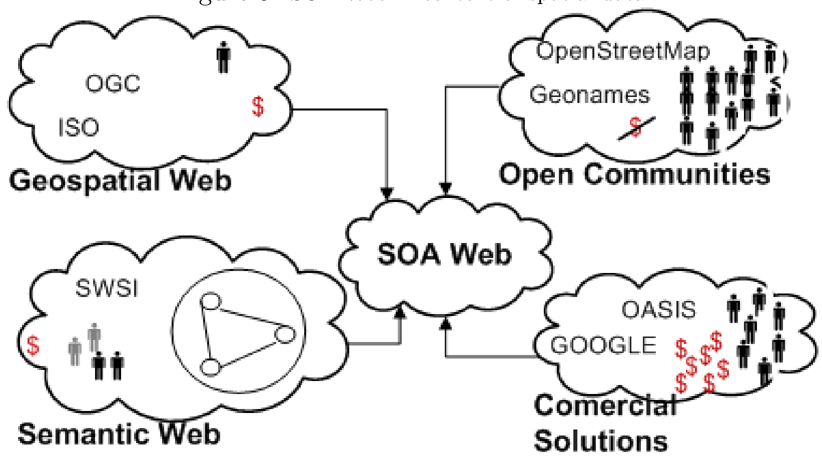
It is important to indicate here the importance and popularity of the services based on REST principles, the so-called lo-REST[13] (or weak-REST[10]) services that implements RPC-style. This type of services are the most common services within the Web 2.0 programming style that gives fundamentals for so-called "mash-ups"[3]. Recently "RESTful" services[14] have become popular as an approach to application integration scenario within Web Services platform. This approach is based on the Resources Oriented Architecture. They are suggested as best suited for basic, ad-hoc integration scenarios compared to "Big" Web Services that are more appropriated to enterprise computing.

3 Spatial Web Services and INSPIRE

Similarly to mush-ups, the INSPIRE-based applications will take advantage of existing Web services to develop different functionalities. Nowadays, in the context of spatial data services, there exists many initiatives that arise from open communities and enterprise suppliers (see Figure 5). The open communities are characterized by the large amount of participants (human resources) that take part in service creation and/or spatial data production which gives grounds to new phenomena know as "neogeography"[15]. As a result, the open communities provide many free ad-hoc services with simple data models, not always appropriate for the complexity of the task. As an alternative, there are the commercial suppliers. They are characterized by access to economic resources which implies the availability of human resources as well. This muscle is reflected in the number of the commercial services and dedicated solutions available in the market. Other stakeholder is the geospatial community. In response to the need of open standards for spatial data they set up the Open Geospatial Consortium (OGC) that establishes service specifications for spatial applications. The last stakeholder that participates in Spatial Web Service platform is the Semantic Web community. They provide Geospatial-aware Semantic Web solutions as DBpedia[2]

The variety of invocation styles, interfaces, etc of Web services is the cause of an integration scenario characterized by the heterogeneity of the technological approaches. Thus, the technological integration of different services might be rather complex and may require multiples ad-hoc adapters. The approach of ad-hoc adapters is not the best approach for a INSPIRE-conformed wrapper service. Publish a set of generic, preconfigured or run time adaptable mediators in the INSPIRE bus registry that follow the well-known patterns seems a more suitable approximation.

Figure 5: SOA Web in context of spatial data.



4 Use of service patterns

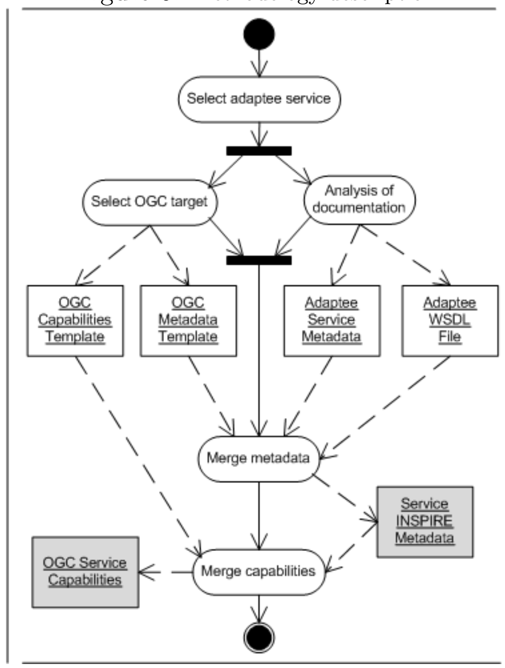
INSPIRE defines interfaces and impose the SOAP-based Service Bus as the backbone for its infrastructure. Taking into account the variety of technology solution used by State Members to provide their services and the heterogeneity of Web services, both commercial and free, the existing services might be adapted by creating a mediator service rather than creating a new one with whole logic or adding new interface to existing services to conform with the requirements which might involve additional costs. The mediator service could be seen as an additional cost. However, depending on each case (for example, if the existing service is provided by third part) the service owner might find this approach profitable.

Depending on users need, there might be used one of the following architectural patterns: adapter and facade pattern. The adapter pattern allows the user to access to functionality of object via known interfaces and/or adopting message channel[8]. In majority of cases the mediator service will implement this pattern to encapsulate the invocation of original service according to INSPIRE SOAP binding requirement. The other pattern offers unified and simplified interface to set of components and deriver Service Facade pattern permits combining various services. The mediator service not only allows changing the interface but also hides the logic for multiples request or error handling.

5 Methodology

The first step of the proposed methodology is the selection of an INSPIRE-unconformable or non-INSPIRE service to be adapted for INSPIRE Service Bus (see figure 6). The available documentation files of the chosen service should be analised to fil in a simple metada template. The model of this template has

Figure 6: Methodology description.



been previously defined in accordance with the requirements of INSPIRE service metadata model implementation rules (see table 2). Although this might sound rather straight, in practice it is not so simple. Usually, popular Web Services (e.g. Google, Yahoo families) lack in standardized documentation. Commonly, the way of consuming of a web service might be provided in form of human-readable documents, an APIs, sample code that the service provider publishes for developers to use. Less frequently the WSDL file is provided, and if miss it should be created during the documentation analysis.

Table 2: Simple metadata model for description of non-INSPIRE or INSPIRE-unconformable services.

Metadata element	**Description**	**INSPIRE MD corresponded field (see A.11.3.1 of [11])**
Language	Language of the metadata	LanguageCode
ServiceName	A short name of service	Identification/Resource Title
HumanDescrition	Breve human-readable description	Identification/Resource Abstract
Provider	Provider identification	-
UseRestrictions	Restrictions about usage (e.g. *Data reuse not allowed*)	useLimitation
AccessRestrictions	Restriction about accessing (e.g. *Licence needed* or *Key-based*)	accessConstraints

The services standarized by OGC are recommend by the INSPIRE IRs. In the most general case, the characteristics of the adaptee service will indicate which OGC service should be implemented. In this paper, we focus only on one of the most relevant OGC service in the INSPIRE context: the WPS. The WPS mediator is appropriate for the services that offer some functionality as route calculation or geocoding. As the WPS is standardized, we have defined a set of template files that are used later. This approach might be generalized to other OGC services.

The next step is creation of INSPIRE metadata of the INSPIRE-conformed/-able service by merging the simple metadata file and WSDL file of adaptee service with OGC metadata templates. The obtained INSPIRE metadata will be used with OGC Capabilities template to create the OGC Service Capabilities file of the target service. The merging process is semi-automatic. Finally, the result files should be revised to check if they fulfil the OGC and INSPIRE recommended requirements.

5.1 Case study - Google Geocoder Service

The address geocoding service is the most popular among the georeferencing services. The Google Geocoder Service has been chosen for case study as an appropriate example of non-INSPIRE services because this functionality seems to be relevant for each system dedicated to public authorities. This service is neither conformed with the interface INSPIRE requirements nor uses the SOAP-based invocation style. What is more, as typical developer-oriented Web Service does not provide any formalized description. As the firs step, the WSDL file and metada file has been created by means of analysis of online documentation[1]. Then, the WPS interface has been chosen as the most approximate for implementation of geocoding functionality. For needs of this paper a simple tool has been developed that automatize the creation of INSPIRE metadata file and the response files of getCapabilities future mediator. The tool perform simple mapping from the corresponding fields of the WSDL and metadata files. However, it should be indicated that the result files needs human revision to add missing elements.

6 Conclusions and future work

This paper has presented a practice of the use of design patterns which provides a mediator layer that simpify service integration process for INSPIRE Service Bus. We propose a methodology that has been applied to a well known service. The result of this work is available online[2].

The following steps of this research work will focus on the optimization of the integration process by decreasing human intervention and generalization of the approach to offer additional OGC interfaces (e.g. WFS) and to connect to multiple commercial services (e.g. ViaMichelin or TeleAtlas services).

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