

## MAKING THE SENSOR OBSERVATION SERVICE INSPIRE COMPLIANT

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The Sensor Observation Service (SOS) [3] provides access to near real-time environmental data, or *observations*, in a standardized way. Thereby, the SOS offers flexible spatial, temporal, and thematic filtering capabilities that enable clients to query and discover large sources of time series data over the Web. The SOS standard is already in version 2.0 [6] and applied in many projects and organizational infrastructures (see e.g., [4]). The data encoding leveraged by SOS is the Observations & Measurements (O&M) standard, which has been introduced in the INSPIRE data specification through the Guidelines for the use of O&M. O&M data can also be accessed through the Web Feature Service (WFS), which has been incorporated in INSPIRE [2] as an implementation of the INSPIRE Download Service [1]. However, the WFS interface is very generic and not optimized for O&M data access. So, an inclusion of the SOS in the INSPIRE Technical Guidance (TG) is desired. Hence, this work analyses the SOS specification on how it can be enhanced to conform to the implementation rules for INSPIRE download services.

### Mapping of INSPIRE Network Services Regulation to SOS

The INSPIRE Network Services Regulation [1] defines abstract implementing rules for two sets of operations for INSPIRE download services: (1) *pre-defined dataset download* and (2) *direct access download*. While the realization of (1) is required, (2) is optional. The TG for the Implementation of INSPIRE Download Services [2] describes how these operation sets may be implemented using Atom or an extended version of the WFS 2.0 standard. Also, it describes how the Atom- and WFS-based TG is mapped to the abstract rules defined in [1]. The pre-defined dataset download operations include the *Get Download Service Metadata*, the *Get Spatial Data Set*, the *Describe Spatial Data Set*, as well as the *Link Download Service* operation. These operations can be mapped in the following way to SOS operations. First, according to [1], the *Get Download Service Metadata* operation shall provide information about the service and the available spatial datasets. The expected request parameters include the natural language to be used for the content of the response, while the response contains the metadata about the service. The behavior of this operation is best reflected by the *GetCapabilities* operation of the SOS. However, the support for natural language selection is missing within the SOS standard. According behavior has to be added to the SOS interface (for all operations). Also, certain INSPIRE specific metadata elements are not yet contained (e.g., conformity regarding the data specification, or the point of contact for metadata) and they need to be added to the SOS *GetCapabilities* response as it has been done for the WFS in [2]. Further consideration must be given to the term “spatial data set”, which can be mapped to the *observation offering* element listed in the SOS *GetCapabilities* response. Such an observation offering groups collections of observations produced by one procedure and lists the basic metadata for the associated observations. Second, *Get Spatial Data Set* operation [1] can be mapped to the *GetObservation* operation containing the identifier of a spatial data set (offering in SOS

terms). The response to such a query contains all observations of the requested observation offering. A spatial filtering profile, as described in [6] should be enabled for the SOS to ensure that the observations offered are restricted to spatial observations. To fully comply with the INSPIRE implementing rules, the *GetObservation* operation needs to be extended to support a coordinate reference system (CRS) as parameter and has to support according CRS transformation. Third, the operation *Describe Spatial Dataset* shall return the description of all spatial object types contained in a spatial data set [1]. Since the central data element of the SOS is the *observation*, we recommend considering it the spatial object. There is no operation that returns the observation type for a given observation offering. Instead, the observation types used by an SOS are listed within the response of the *GetCapabilities* operation, thus, qualifying for the implementation of the *Describe Spatial Dataset*. Fourth, the *Link Download Service* shall allow the declaration of the availability of a Download Service and its hosted data [1]. This operation can be implemented in the same way as for the WFS, by deferring this task to the INSPIRE compliant discovery service.

Next, the *direct access* download operations include the *Get Spatial Object*, and the *Describe Spatial Object Type* operation. These operations can be mapped in the following way to SOS operations. The *Get Spatial Object* operation allows the retrieval of spatial objects based upon a query [1]. Since we consider the *observation* as the spatial object at an SOS, the *GetObservation* operation can be used. However, the *GetObservation* operation needs to be extended to include a CRS parameter. The *Describe Spatial Object Type* operation can be mapped to the *GetCapabilities* operation, since the observation types used by the SOS are listed in the contents section of the *GetCapabilities* response.

## Conclusions & Outlook

We have outlined how the SOS can be made compliant to INSPIRE Network Service Regulation [1] requirements. Especially for the INSPIRE topics relying on the O&M model, the SOS will enhance the INSPIRE framework with a Web service type that increases interoperability for the exchange of observation data. Similarly to the WFS extension defined in [2], some extensions for the SOS are needed to comply with all legal requirements in [1]. The Technical Guidance [2] should at the same time be extended to include an SOS dedicated section.

## References

- [1] INSPIRE Network Services Regulation, Commission Regulation No 976/2009.
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