Paper for Consideration by TSMAD

S-100 XML Encoding

Submitted by:	UK/Jeppesen
Executive Summary:	This paper reports on work by the UK and Jeppesen to develop XML encodings for S-100 products. The UK work stems from a requirement for a Route Exchange format.
Related Documents:	1. S-100 2. HSSC3-INF9 3. e-Nav 10 INF 7
Related Projects:	1. S-100

Introduction / Background

1. The UK has received user feedback that a standard route exchange format for ECDIS is required. In considering a solution the UK identified that to support an S-10x data specification a lightweight encoding would be required. Given existing work on GML and the fact XML is a widely used encapsulation for a variety of data types work was undertaken to develop a lightweight XML encoding. This was based on the premise that a maximally concise XML form could support a variety of S-100 products/data exchange requirements.

2. Jeppesen is developing an XML-based data format for mariner's routeing guide information for the BLAST project. Given the interest in using GML as an encapsulation for S-100 data, it was decided to use GML 3.2.1 to support the XML encoding of this data. XML schemas for an XML encoding of this information were built and used to encode sample data generated by BSH, NHS, and KMS.

Analysis/Discussion

3. The results of the UK work to date can be found at Annexe A and consist of an XML Schema along with an example application schema and dataset. The work is closely based on the GeoRSS GML profile and uses many GML constructs but expands to cover S-100 requirements and incorporate an updating model. This approach was chosen because it avoids the need to implement a full GML profile which would have to be extended anyway. This approach reflects that various systems which would not support the complexity of GML might read or output this XML form. The UK feels that a GML encapsulation may be required in addition for certain products but that there is also a requirement for a less verbose alternative.

4. As part of work with BSH, NHS, and KMS for the BLAST project, Jeppesen have developed a schema for mariner's routeing guide data which extends GML to support S-100 requirements. GML schemas were obtained from the Open Geospatial Consortium and used to derive an XML encoding. The GML schemas are imported and used directly in the encoding. The purpose was to explore the issued in using GML for S-100-related data as well as provide a demonstration of standards-conformant, harmonized, nautical publications information compatible with the S-100 framework. This work is described at Annexe B.

5. For the BLAST work, sample data for the XML encoding was prepared by BSH, NHS, and KMS from portions of their sailing directions and other publications pertaining to the vicinities of Wilhelmshaven, Stavanger, and Hirtshals respectively. The information was mapped by the Hydrographic offices to the SNPWG data model, to produce Excel spreadsheets giving objects, attributes, and their values. This was converted to XML. A description of the results is included in Annexe B.

6. Separately from the foregoing, Jeppesen and the Norwegian Coastal Administration have developed a “proof-of-concept” model of non-geographic information as part of a feasibility study into using S-100 for non-hydrographic information. This work focused on using the S-100 framework to create an exploratory partial model Notice of Arrival and Pilot Requests (NOAPR) in Norway. A prototype product specification based on the S-100 standard was developed describing the data model. The results of this investigation are described in a paper presented at the 10th meeting of the IALA e-Navigation Committee (e-NAV10/INF/7), which was also submitted as an HSSC3 information paper and is available for download from IHO HSSC-3 documents webpage (HSSC3-INF9). This model is another suitable domain for the development of XML encodings compatible with S-100.

Conclusion

7. Clearly in order to support a wide range of data types additional encodings will be required in S-100. XML encodings based on GML are likely to offer the best route to develop suitable encodings. The efforts described in this paper demonstrate such encodings and explore some of the possible paradigms for such encodings. The UKHO and Jeppesen efforts are very similar in taking up GML as a basis but differ in their utilisations of it. The fundamental difference is to profile and use GML or replicate in a single schema approach which supports updating etc. There are advantages and disadvantages of both approaches and it may be that there is a place for both approaches to be further developed. The results (the XML data files) are expected to look similar though not identical.

Action Required of TSMAD

- To review the work done by the UK and Jeppesen, to discuss the impacts for S-100 and propose next steps.

Annexe A – UK Work

The results of the UK work on this are provided in the following documents accompanying this paper;

XML Schema – S-100 XML Schema.xsd

The XML schema defines the base types used in application schemas which import this schema.

Route Application Schema – RouteAppSchema.xsd

The application schema imports the S-100 XML Schema to define specific features, attributes, information types and associations used in a specific product.

Sample Dataset – testdatasetroute.xml

This sample dataset contains a range of features, attributes and associations. It validates against the Route Application Schema. This dataset can be viewed in the free Snowflake GML Viewer but the links will only work if the s100:id’s are amended to gml:id using find and replace.

Annexe B Jeppesen Work on mariner's routeing guide information

Domain Model

Features and attributes were selected for inclusion in the domain model based on the guidelines for mariners' routing guides provided by the IHO publication "Standardization of Mariner's Routeing Guides" [S49], augmented with selected features from the SNPWG model which were are needed to capture the types of information commonly available in routing guides currently published by hydrographic offices (BSH and UKHO). Some notable points about the Digital Mariner's Routeing Guide (DMRG) domain are:

- Geographic and information types are derived from separate abstract types for geographic and information objects.
- Four closely related information types (Regulations, Restrictions, Recommendations, and Nautical Information) are derived from a common intermediate abstract type, while the other information types are derived directly from the abstract type *InformationType*.
- Geographic feature types are derived from the abstract type *FeatureType*.
- An information type (*Applicability*) is defined which allows definition of various subsets of vessels according to vessel characteristics such as the type of cargo, type of vessel, vessel measurements, equipment, etc. This is used in 2 ways:
- To capture conditional regulations (or restrictions, etc.) whose applicability or non-applicability to vessels is determined by vessel characteristics or cargo. This is modelled by the association class *AppliesTo* which links the Applicability class to the abstract super-class of the pertinent 4 information types.
- To capture conditional restrictions or permissions relating to passage or vessel activity at the location of a geographic location. This is modelled by the association class ActRelationship which links the Applicability class to the abstract super-class of all geographic feature types. (A more precise model would devise means of associating it only to features where conditional restrictions or permissions are actually used, but the large number of geographic feature types makes that level of precision laborious.)

The feature catalogue contains 95 features and 40 attributes from the ENC domain, and 18 features, 109 attributes, and 9 information objects from the nautical publications domain. The large number of features in the mariner's routeing guide information product specification means it is difficult to produce a diagram displaying the whole model, and therefore only the significant components are included in Figure 1**Error! Reference source not found.**.

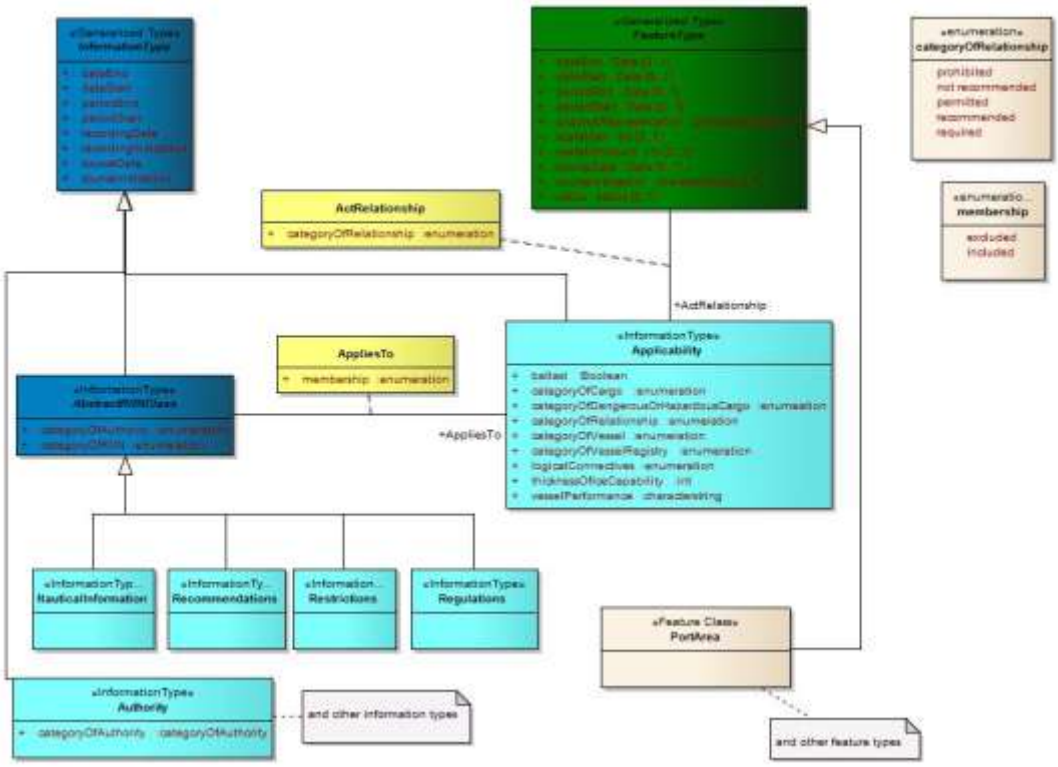

Figure 1. Domain model for mariner's routeing guide information

Schemas

The XML schema model for DMRG information consists of the following components:

- A set of base schemas defining S-100 primitive types.
- A feature definition schema defining generic and abstract types for geographic and information features and associations, as defined in S-100. This schema imports the GML 3.2.1 schemas and uses GML constructs for implementing features and associations.
- A product schema which implements the DMRG feature catalogue by defining features and attributes, binding attributes to features, and implementing feature and information associations. This schema uses the above schemas.
- A dataset schema which describes the structure of a DMRG dataset.

Figure 2 shows the relationships between schema components.

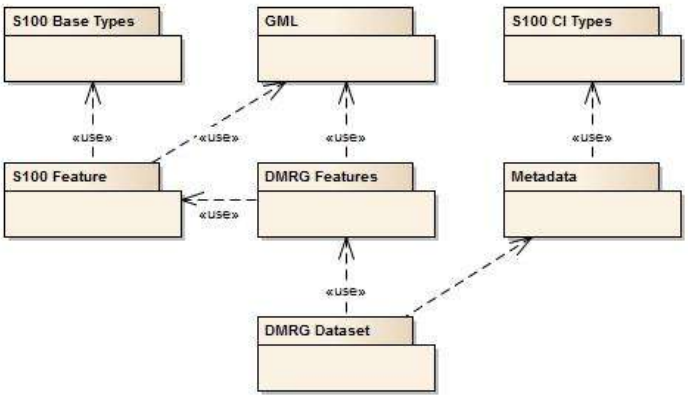

Figure 2. Schema components for DMRG information

The schema model also provides for metadata information (not yet implemented).

The encoding is capable of coding geographic features, information objects, simple and complex attributes, feature associations, information associations. **Error! Reference source not found.** shows the XML encoding of the feature type for Marine Service – the components shown are a pointer to the object geometry (XML element *spatialref*), association to information objects (element *informationAssociation* in the figure), certain simple attributes common to all feature types and inherited from abstract types (in the boxes for *AttributeGroupB* and *AttributeGroupC*), and attributes specific to this feature (*categoryOfMarineService*, *serviceAccessProcedure*, etc.).

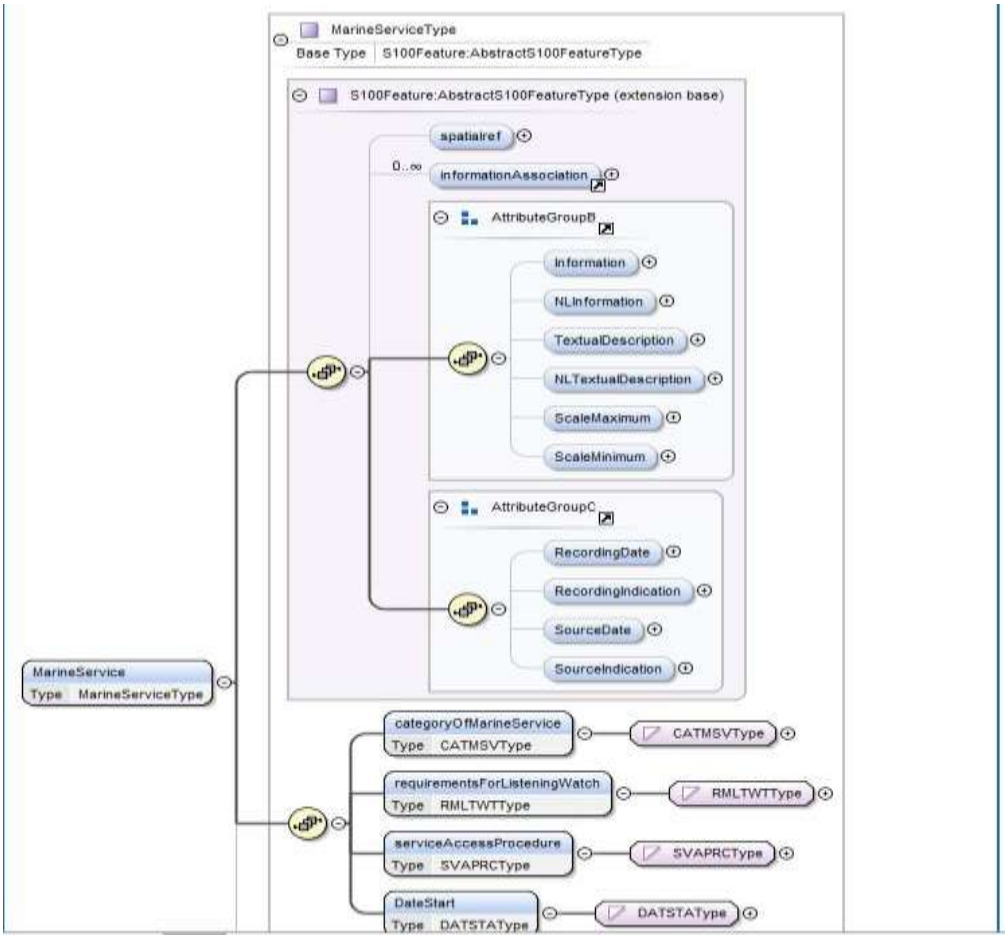

Figure 3. Typical feature encapsulation

Sample Data

Figure 4 below shows the XML code corresponding to a VTS area. It uses the *MarineService* object of **Error! Reference source not found.** and includes, in order, the coordinates of the area (in decimal degrees with a multiplication factor of 10^7 applied), associations to three information objects (2 regulations objects and 1 for contact details), and simple attributes describing the type of feature (value 1 = VTS), requirements for listening watch for this area, and the effective date of the VTS area.

```
- <dmrg:MarineService gml:id="mrnsrv01">
  - <spatialref>
    - <gml:Polygon gml:id="a01">
      - <gml:exterior>
        - <gml:LinearRing>
            <gml:posList srsDimension="2">052398333 595491667 051848333 595748333 048933333
              595750000 047300000 593266667 047133333 592883333 047283333 592383333
              050900000 590933333 052483333 589816667 053600000 587500000 054933333
              587500000 052398333 595491667</gml:posList>
          </gml:LinearRing>
        </gml:exterior>
      </gml:Polygon>
    </spatialref>
    <S100Feature:informationAssociation gml:id="mrnsrv01andreglts01A" xlink:href="#reglts01A" />
    <S100Feature:informationAssociation gml:id="mrnsrv01andreglts01B" xlink:href="#reglts01B" />
    <S100Feature:informationAssociation gml:id="mrnsrv01andcondet02" xlink:href="#condet02" />
    <dmrg:categoryOfMarineService>1</dmrg:categoryOfMarineService>
    <dmrg:requirementsForListeningWatch>Vessel in motion or at anchor in the area shall keep a continuous listening
      watch on the traffic unit's working frequency. Permission to change to another frequency or to cancel the watch
      must be obtained from "KVITSØY CONTROL".</dmrg:requirementsForListeningWatch>
    <dmrg:serviceAccessProcedure>VHF channel 18 (S), VHF channel 19 (N)</dmrg:serviceAccessProcedure>
    <dmrg:DateStart>2003-01-01T20:00:00+01:00</dmrg:DateStart>
  </dmrg:MarineService>
```

Figure 4. Typical feature in XML

The XML can be viewed with an off-the-shelf (free) GML viewer – see[1] Figure 5.

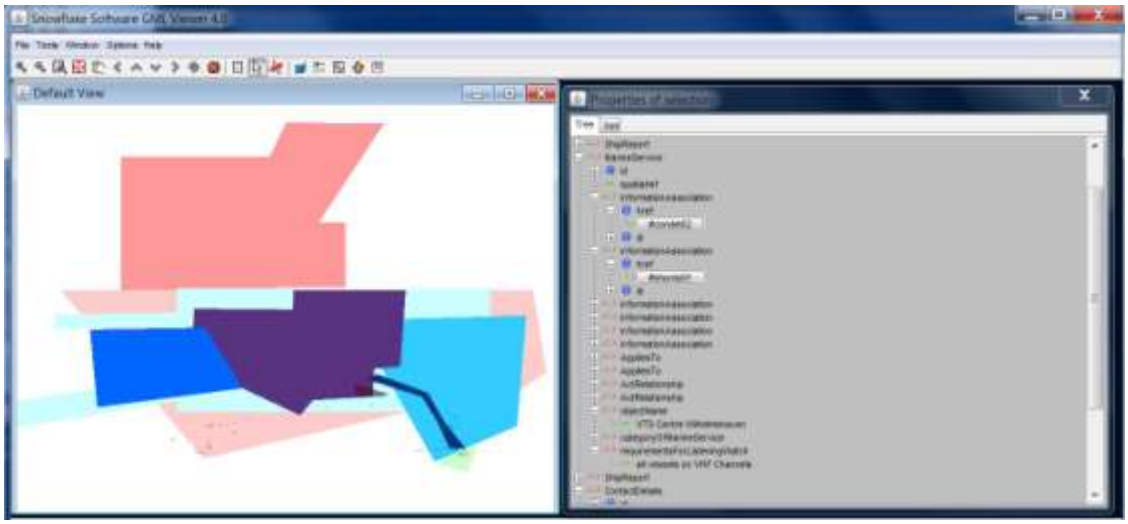

Figure 5. Selected feature polygons and data for routeing guide information

[1] Colours: Sea Area: light blue; Pilot Service area: medium blue; Marine Service: deep blue; Military Practice area: dark pink; Restricted Area: light pink; Caution Area; red; Port Area: yellow; Natural Conditions area: green. The purple area is a highlight of the picked Marine Service area object.