Paper for Consideration by S-100 WG8

Spatial Attributes description and implementation in S-100

Submitted by:	Canadian Coast Guard (Eivind Mong)
Executive Summary:	Paper highlights observed discrepancies with regards to how spatial attributes are described in S-100 and how they are implemented in the S-100 Infrastructure.
Related Documents:	S-100, S-124
Related Projects:	S-100, machine readable generic products

Background

S-100 is the Universal Hydrographic Data Model, and has been offered to the world as the Common Maritime Data Model for e-Navigation (MSC.1/Circ.1595, S4.1.1). However, and perhaps unavoidable, there are still peculiarities in the framework that are traceable back to the original use case of ECDIS, and sometimes these are un-documented and leaving room for interpretation and possible misunderstandings when the S-100 framework is used in other communities.

One such peculiarity that has recently surfaced in the S-124 Navigational Warning product specification development is the intent to use geometry to both locate a feature and its area of impact. This modelling was reported widely within the IHO and other stakeholder communities without anyone noting the issue. Originally modelled as two different spatial attributes for a feature class, it faced a 'show-stopper' when it came time to submit the concepts to the GI Registry, the two spatial attributes were not supported by the IHO infrastructure. Upon investigation some ambiguities were noted in the S-100 framework. This paper seeks to identify them as it is strongly believed that these ambiguities should be resolved before the 2026 genesis for the S-100 ECDIS.

Discussion

Although the initial use case was resolved by a change in the modelling, a change that required the creation of a new feature class, attributes and associations, it can be envisioned that without clarifying the function of spatial attributes in the S-100 framework, other groupings wishing to use S-100 may face similar challenges if the S-100 framework is not clarified and the issue resolved.

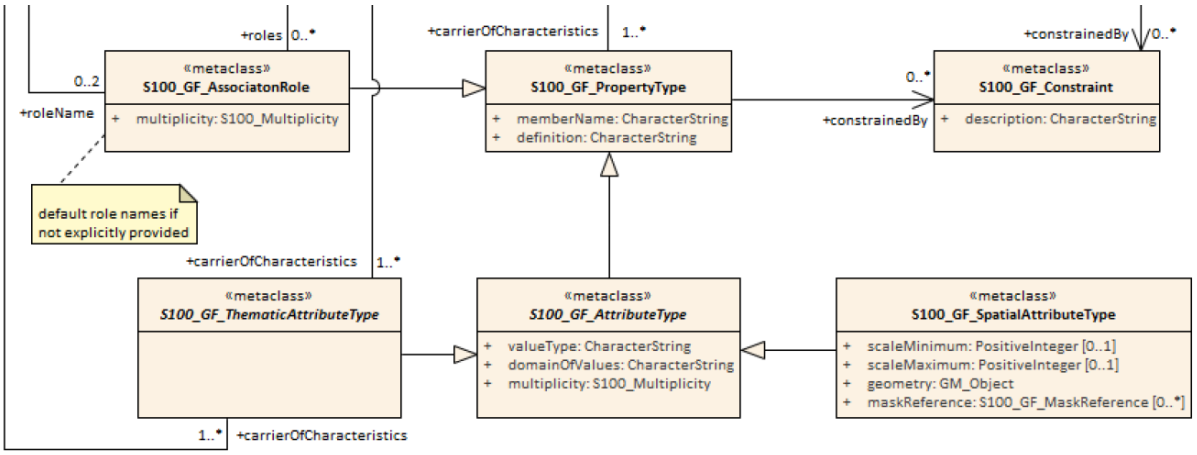

Figure 3-1 – The General Feature Model

Figure 1 - Extract from the S-100 GFM

The S-100 General Feature Model (GFM) allows as many spatial attributes as one wish to associate with a feature class. Moreover, the GFM dictate that spatial attributes should be named, given a definition, have a value type, a domain for the values and an indication of how many instances are permitted for each feature class. These are requirements inherited through the S100_GF_PropertyType and S100_GF_AttributeType classes.

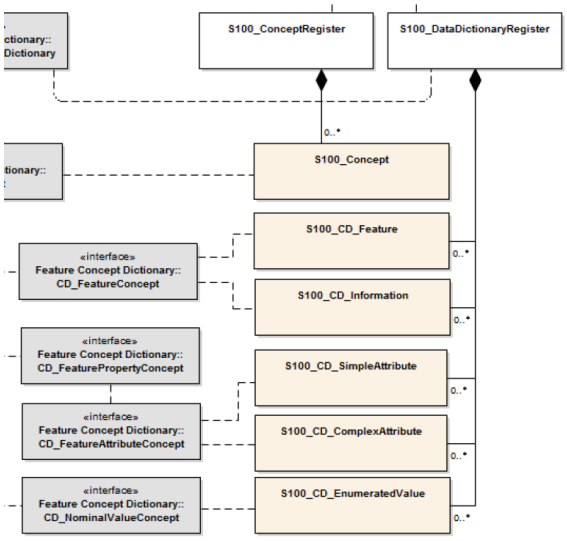

Figure 2 - Extract from the S-100 Registry Relationships model

The Concept and Data Dictionary Registers does not have a slot or category for spatial attributes, but it may be possible to handle these under simple attributes. Support for spatial attributes in the IHO GI Registry would be necessary to sufficiently manage the requirements placed on spatial attributes by the GFM.

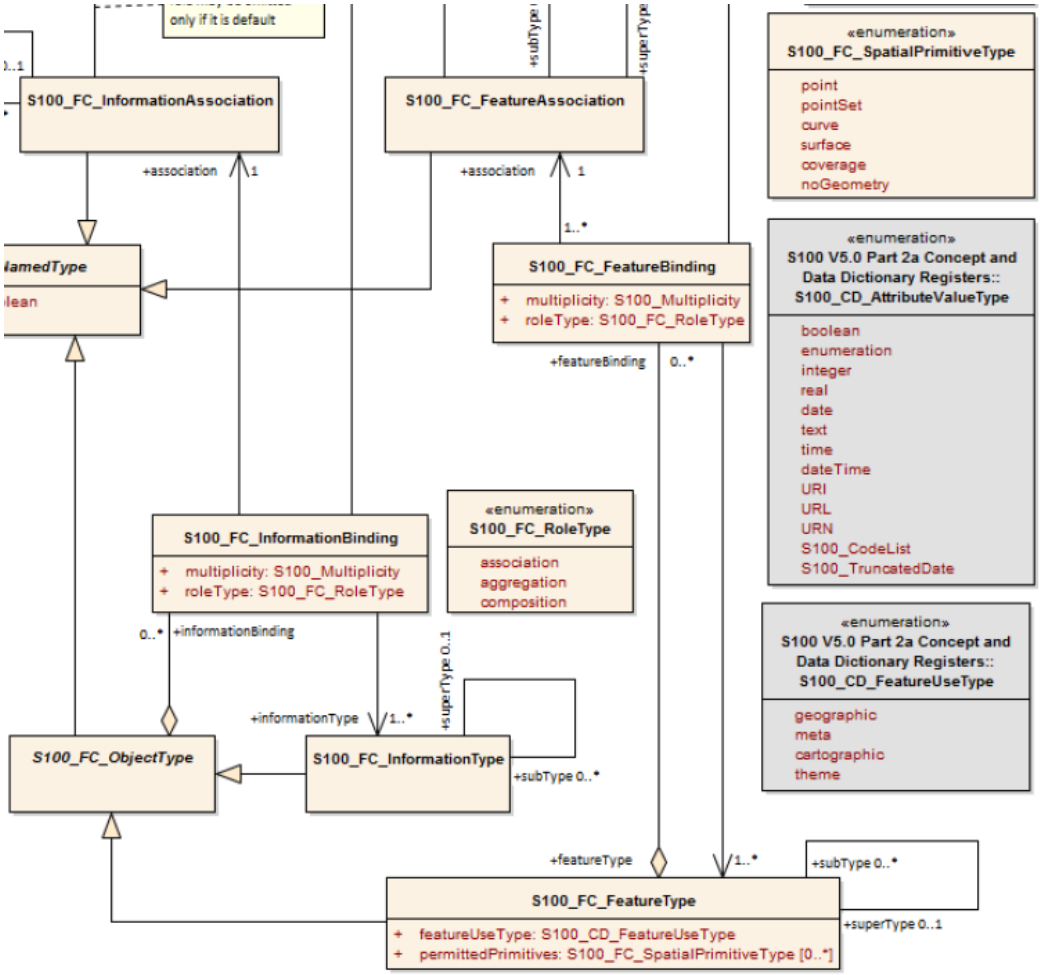

Figure 3 - Extract from the Feature Catalogue model

In the feature catalogue the feature type can only have zero to many spatial primitives (permittedPrimitives attribute in the S100_FC_FeatureType class), but no explanation is given for how to apply spatial attributes. The method for linking geometry to a feature is generally found in the encoding sections of S-100, but a new reader S-100 will probably find it challenging to make that connection. The S-100 reader have to first identify which encoding to utilize, before the method to manage geometry is explained, but there is little indication given that spatial attributes have no place in the feature catalogue.

For ISO 8211 encoding this is done by a reference to spatial records by a spatial association field (see 10a-5.10 for details). But no means have been given for name or definition of spatial attributes. For GML encoding the spatial information is placed within the <geometry> named tag (see example in Figure 10b-6), and here as well, no means have been given for name or definition of spatial attributes. The pattern is repeated for HDF5, where Table 10c-5 shows well the structure of the HDF5 file, which has the spatial directly linked with the feature without any attribute name in between. Although this approach is consistently applied between the three defined encodings in S-100, there remains the issue that this approach is incompatible with the GFM. Moreover, it ensures that there cannot be a distinguished use of different spatial attributes from a feature instance, and if such a use case is needed, the only approach that remains, is to use an associated feature class to express the additional use of spatial information. This approach is manageable, but cumbersome and not obvious from the S-100 framework.

Use cases and examples where different spatial attributes are beneficial

Example use cases can be any situation where there is a need to give a feature different spatial representation under different contexts. The S-124 use case was that the same warning message has a spatial foot print by itself, but also an area of impact. For example, a light stops working is marked at the location of the light, but the area where the light is observable under normal circumstances is the area of impact. A similar case if when a radio transmitter is offline, and located far inland, the area of impact would indicate where the missing transmissions may be experienced. A further use case can be when there is a need to have the spatial attribute change to express uncertainty. For example, a sounding has a point, but with its uncertainty applied that point can be expressed as an area. The visualization of this area can be simplified by including an additional spatial attribute to hold the area geometry that results when the uncertainty is applied. This could reduce the need for computational resources onboard as it can be done on shore and by the data producer. A similar use is for radio stations where terrain and atmospheric conditions impact transmission range, and the different qualities of service may be expressed as increasing sized areas, such as s smaller area for 95% certainty of receipt of transmission and a larger area for 50% certainty of receipt of transmission.

Conclusion

Spatial attributes are well defined in the GFM. The FC model and the encoding parts of S-100 have taken a different path from GFM on spatial attributes. The documentation of this discrepancy is limited. There are several use cases for more than one spatial attribute in S-100 data models that can improve the data modelling by using more than one spatial attribute.

Action Required of S-100 WG

The S-100 WG is invited to:

a. Note this paper
b. Consider ways to address the discrepancies highlighted