Paper for Consideration by S-101 PT

S-101 UML Model Status (Information Paper)

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Executive Summary:	Describes work on the S-101 1.0.0 UML model and preliminary findings..
Related Documents:	--
Related Projects:	S-101

Introduction / Background

This paper describes the status of a UML model for S-101 and preliminary findings arising from the work.

References

S-101 Annex A – Data Classification and Encoding Guide (DCEG) Version 1.0.0 (December 2018).
S-101 Feature Catalogue – XML file (9 April 2019).

Discussion

Under contract with NOAA, a UML model for S-101 is being developed, based on Version 1.0.0 of the S-101 DCEG. This work has reached an advanced stage but is not yet complete. The model is intended to conform to Version 1.0.0 of the DCEG with the exception of the multiplicities of certain association roles, which are being updated to improve the model's strict correctness and conformance to domain truth.

The model is summarized below.

- The classes, attributes, and enumerations conform to the S-101 DCEG and XML feature catalogue. In case of disagreement between the DCEG and feature catalogue, the UML follows the DCEG.

- The associations also conform to the DCEG and feature catalogue, again with the DCEG prevailing in the case of a discrepancy, but role multiplicities are changed to correct clearly invalid relationships. For example, the DCEG declares multiplicity "1..1" for all feature bindings for geographic features in **TextPlacement** (clause 23.1), which formally requires each instance of **TextPlacement** to have a feature association pointing to every instance of every geographic feature class (except meta-features). However, clause 2.6 clarifies that such multiplicities are actually a collective constraint. The feature catalogue represents this exactly as in clause 23.1 (lower bound 1 for each feature binding in **TextPlacement**), which is formally incorrect when clause 2.6 is taken into consideration.

  In the UML model, the multiplicity is set to the correct bounds "0..*" and annotations are added to the affected roles to indicate the collective constraint. The situation for **UpdatedInformation** is similar.

- Each feature and information class has an *Attributes* diagram depicting the feature class, its attributes (including complex attributes), and related enumerations. Associations are omitted from this diagram.

- Each feature and information class also has a *Relationships* diagram depicting the relationships of the class. Attributes and enumerations are omitted from this diagram.

- Additional diagrams will be prepared as appropriate to provide overviews or examples of significant S-101 concepts, e.g., the modelling of navigation aids as combinations of structure and equipment features. These diagrams will supplement the figures in the main Product Specification document as needed.

- A diagram annotated with explanations of modelling notation (especially the collective constraints) will also be prepared.

In the course of constructing the UML model, we have discovered some discrepancies and inconsistencies in the DCEG and feature catalogue cited in the References section. For example:

1) Feature type **CautionArea** in the feature catalogue has a duplicate feature binding to **ArchipelagicSeaLane**.

2) In the feature catalogue, **TextPlacement** has a mandatory feature binding to every geographic feature. This appears to be based on the relevant clause in the DCEG, but the intent of the DCEG is that **TextPlacement** must be bound to one feature instance from the whole set, not one instance of each class in the set. The situation for **UpdatedInformation** is similar.

3) Similar problems exist in the feature catalogue for some other more specific associations, e.g., **TrafficSeparationSchemeAggregation**, **AidsToNavigationAssociation.**

4) **CautionAreaAssociation** and **AidsToNavigationAssociation** in the DCEG are *associations* with *consistsOf/componentOf* roles. Other associations with these roles (**ASLAggregation**, **RangeSystemAggregation**, **PilotageDistrictAssociation**, **BridgeAggregation**, etc.) are *aggregations*.

5) Clarification of DCEG intent regarding the omission of associations from feature tables is being sought. Some feature associations appear in one feature table but not the converse. This omission appears to be intentional in places and inadvertent in others. The S-101 UML will assume that such associations are intended to be unidirectional (the April 9 feature catalogue apparently agrees).

   For example, **BeaconCardinal** (clause 20.9) lists an **AidsToNavigationAssociation** to **TrafficSeparationScheme**, but the **TrafficSeparationScheme** table (clause 15.24) does not list an **AidsToNavigationAssociation** association to **BeaconCardinal**. The converse is true for the association **TrafficSeparationSchemeAggregation**. This is logically consistent when interpreted as follows:

   a. **BeaconCardinal** instances can have **AidsToNavigationAssociation** links to **TrafficSeparationScheme** instances but not the reverse;

   b. **TrafficSeparationScheme** instances can have **TrafficSeparationSchemeAggregation** links to **BeaconCardinal**, but not the reverse.

   The Traffic Separation Scheme model figure later in this paper describes the apparent model.

6) In other places, the treatment of relationships appears to be inadvertent; for example, the treatment of **LightAllAround** and **LightSectored** in the Traffic Separation Scheme model.

We are compiling a comprehensive list of discrepancies and will provide it for the next S-101 PT meeting.

Examples

Snapshot examples of Relationships and Attributes diagrams are included below. Note that the large number of relationships for some classes requires replacing the actual class boxes by text lists of class names, as in Figure 1 below.
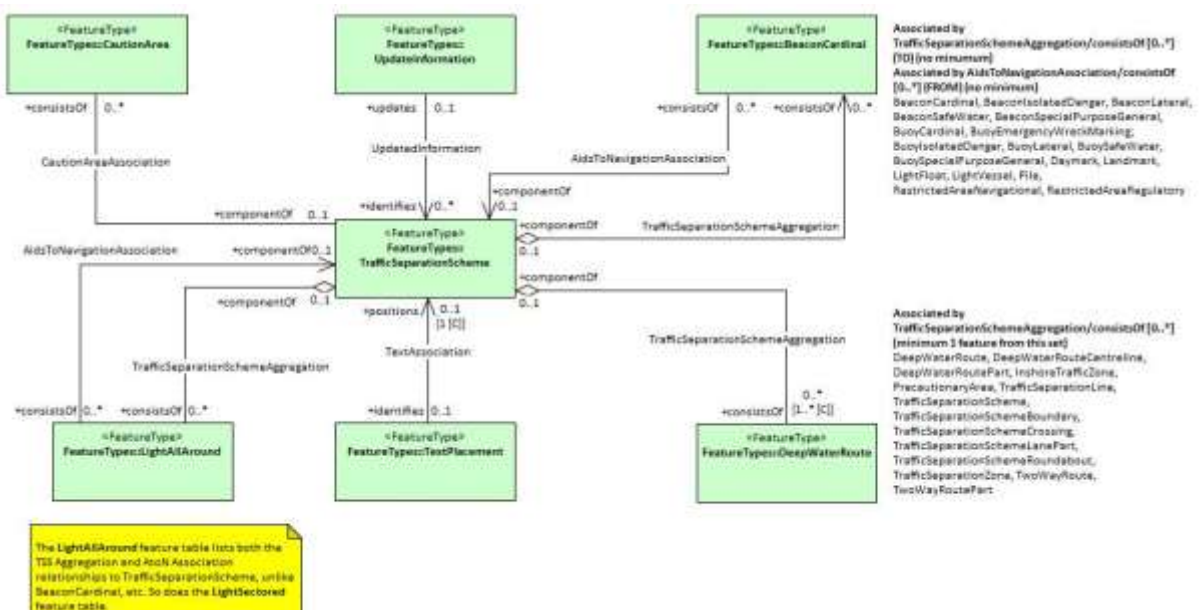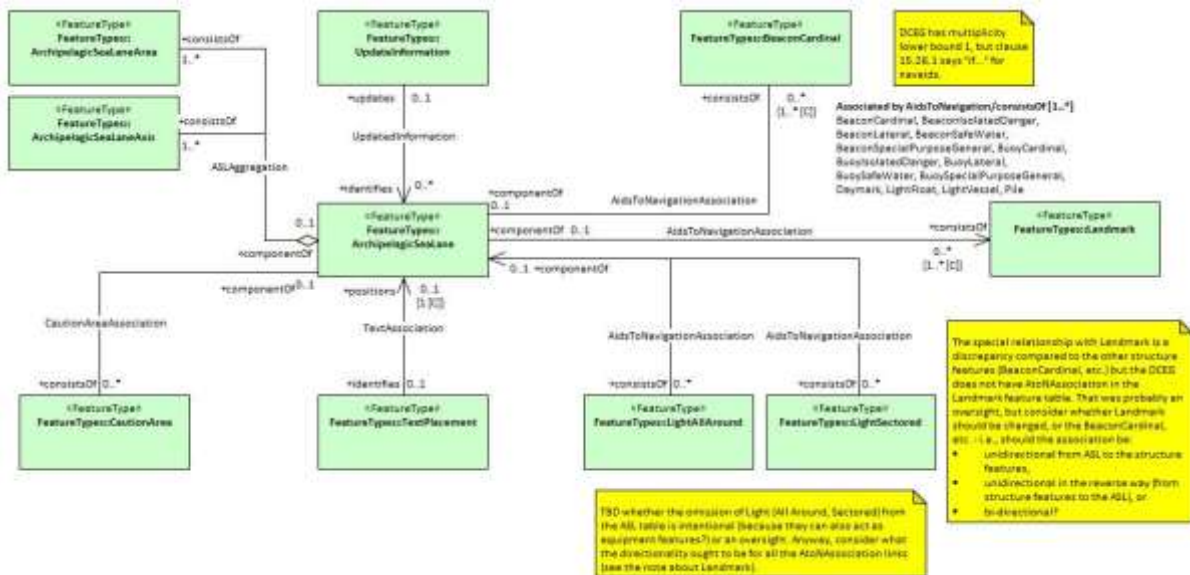

Figure 1. Traffic Separation Scheme model

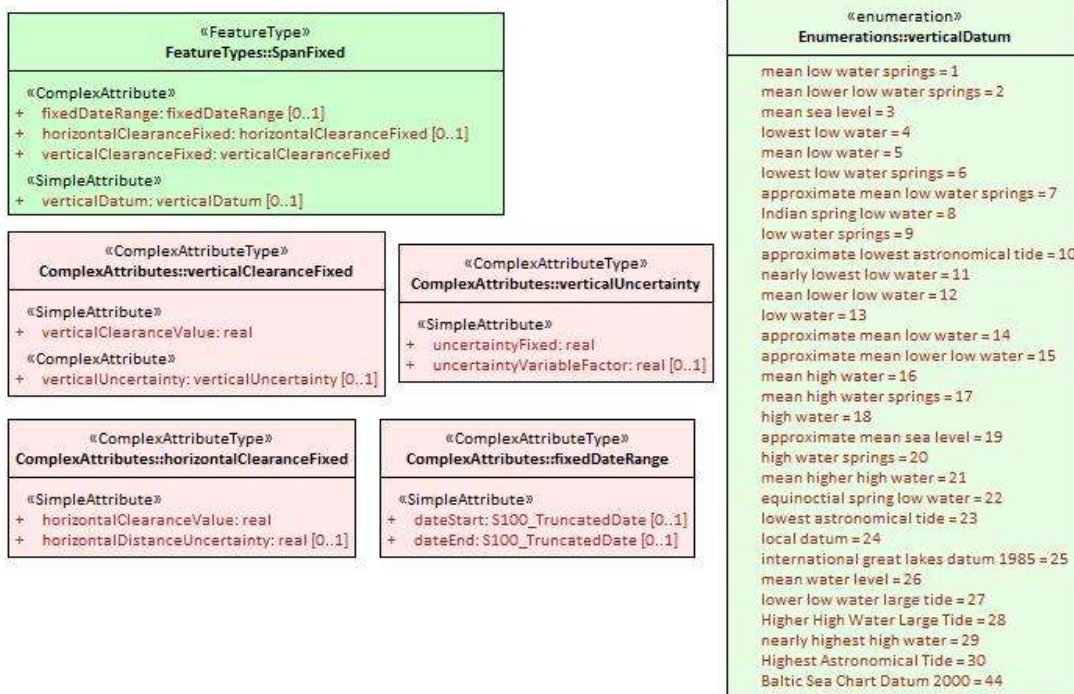*Figure 2. Archipelagic Sea Lane Relationships*

Figure 3. Example of Attributes diagram

Action Requested of the S-101 PT

The S-101 Project Team is invited to:

      a.   Note this paper.