

Paper for Consideration by S-100 WG

Roles in Feature Catalogues

Submitted by:	Raphael Malyankar vice S-101PT
Executive Summary:	Clarification of the use of association roles in Feature Catalogues.
Related Documents:	S-100 Maintenance proposal
Related Projects:	S-100; S-101, S-122, and other product specifications that use feature associations

Introduction / Background

Difficulty with the encoding of roles in feature catalogues was brought to the attention of the S-101 PT by NIWC in late 2020 and discussed following S-101 PT5 and at and after TSM8. This paper presents the results of the discussion at the relevant meetings and on the S-100 WG GitHub site (<https://github.com/IHO-S100WG/TSM8/issues/14>).

Feature catalogues developed to date may not properly designate the type of an association end, for example, which of the two objects in a composition is playing the role of “containee” and which is playing the role of “container.” For example, in the S-100 1.0.0 Feature Catalogue, the TrafficSeparationSchemeAggregation feature bindings use the same role type in both feature bindings.

In TrafficSeparationScheme:

```
<S100FC:featureBinding roleType="aggregation">
  <S100FC:multiplicity>
    <S100Base:lower>0</S100Base:lower>
    <S100Base:upper xsi:nil="true" infinite="true"/>
  </S100FC:multiplicity>
  <S100FC:association ref="TrafficSeparationSchemeAggregation"/>
  <S100FC:role ref="consistsOf"/>
  <S100FC:featureType ref="TrafficSeparationSchemeLanePart"/>
</S100FC:featureBinding>
```

In TrafficSeparationSchemeLanePart:

```
<S100FC:featureBinding roleType="aggregation">
  <S100FC:multiplicity>
    <S100Base:lower>0</S100Base:lower>
    <S100Base:upper xsi:nil="false" infinite="false">1</S100Base:upper>
  </S100FC:multiplicity>
  <S100FC:association ref="TrafficSeparationSchemeAggregation"/>
  <S100FC:role ref="componentOf"/>
  <S100FC:featureType ref="TrafficSeparationScheme"/>
</S100FC:featureBinding>
```

In the above case, systems need to hard code the determination of which class is “container” and which “containee” based on the value of Role (e.g., consistsOf/componentOf, supports/supportedBy, etc.). This does not follow the guidance of S-100, and requires additional product-specific coding or data files. Adding new roles to the feature catalog will require software updates under this regime.

Feature catalogues affected by this issue should be corrected.

Further, S-100 4.0.0 clauses 5-4.2.5.2 (Feature Bindings) and Table 5a-19 should be clarified to ensure that the role type is properly coded in feature catalogues.

References

ISO 19110:2005, Geographic Information – Methodology for feature cataloguing.

S-101PT6-INF-03/S-100 TSM8 6.8, Roles in Feature Catalogues.

GitHub: <https://github.com/IHO-S100WG/TSM8/issues/14>

Discussion/Analysis

Clarification of Clause 5-4.2.5.2

For machine readability, the role type in feature catalogues should indicate which end has the aggregation/composition and which end is the simple association.

While S-100 clause 5-4.2.5.2 (reproduced below) does require that the role types at opposite ends of aggregations and compositions are different, this clause is inconsistent. It appears to require that the feature catalogue give the name and multiplicity of one end of the relationship together with the role type of the other.

5-4.2.5.2 Feature Bindings

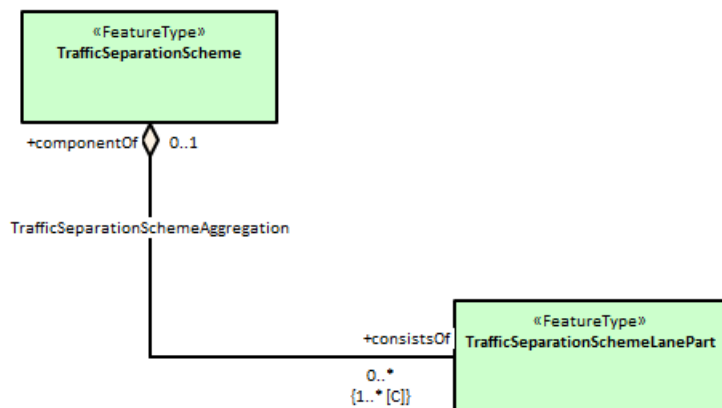
The feature binding describes the association between two feature types. Both the feature association and the association role are specified together with the target feature type. Furthermore the Multiplicity and the role type are defined. The latter describes the nature of the role.

EXAMPLE The role 'Lane' used by a traffic separation scheme to associate its lane parts will have the role type Aggregation, whereas the role "Scheme" used from the lane part to the TSS has the role type Association.

This clause should be clarified to:

- correct the wording so that the name, multiplicity, and role type are mutually consistent;
- add examples of UML diagrams and feature bindings in feature catalogues.

The example UML diagram is below (note - diagram may need an update based on the disposition of an anticipated proposal to allow encoding of multiple features in a single feature binding):



The example:

In TrafficSeparationScheme:

```
<S100FC:featureBinding roleType="association">
  <S100FC:multiplicity>
    <S100Base:lower>0</S100Base:lower>
    <S100Base:upper xsi:nil="true" infinite="true"/>
  </S100FC:multiplicity>
  <S100FC:association ref="TrafficSeparationSchemeAggregation"/>
  <S100FC:role ref="consistsOf"/>
  <S100FC:featureType ref="TrafficSeparationSchemeLanePart"/>
</S100FC:featureBinding>
```

In TrafficSeparationSchemeLanePart:

```
<S100FC:featureBinding roleType="aggregation">
  <S100FC:multiplicity>
    <S100Base:lower>0</S100Base:lower>
    <S100Base:upper xsi:nil="false" infinite="false">1</S100Base:upper>
  </S100FC:multiplicity>
  <S100FC:association ref="TrafficSeparationSchemeAggregation"/>
  <S100FC:role ref="componentOf"/>
  <S100FC:featureType ref="TrafficSeparationScheme"/>
</S100FC:featureBinding>
```

Revision or clarification of enumeration S100_FC_RoleType

The role type definitions in ISO 19110 (Table.11) are given below. “Member role” in the definition is confusing because “member role” would appear to refer to the “containe” in an composition association, but in UML it is the “container” end that is decorated with the diamond and designated aggregationKind=composite. A similar problem arises for “part role” and aggregations.

Table B.11 — Role type code list

No.	Concept name (English)	Code	Definition
11	Class FC_RoleType	—	code list for the classification of roles
11.1	Ordinary	ordinary	indicates an ordinary association
11.2	Aggregation	aggregation	indicates a UML aggregation (part role)
11.3	Composition	composition	indicates a UML composition (member role)

The role types in S-100 are listed in Table 5-A-19:

Table 5-A-19 — S100_FC_RoleType

Role Name	Name	Description	Remarks
Enumeration	S100_FC_RoleType	Defines the type of a role	
Literal	association	An association is used to describe a relationship between two feature types that involves connections between their instances	
Literal	aggregation	An aggregation association is a relationship between two feature types, in which one of the feature types plays the role of a container and the other plays the role of a containee	
Literal	composition	A composition association is a strong aggregation. In a composition association, if a container object is deleted then all of its containee objects are deleted as well. In other words containee objects cannot exist without the container object	

The ISO definitions refer to association roles (“part role” and “member role”) while the S-100 definitions describe the associations themselves. The S-100 definitions should be revised to make it clear that they describe the association **ends**.

While using “aggregation” and “composition” for association ends as well as associations appears to be a source of confusion, this paper is NOT recommending defining different literals for associations ends (for example, “none”, “shared”, “composite”, as in the UML specification) because this requires a modification of the feature catalogue model.

Alternative approaches: Modifying the encoding of associations and roles in the S-100 feature catalogue model

S-100 models feature associations differently from ISO 19110. Modifying the S-100 feature catalogue model to conform more closely to ISO 19110 offers another path to resolving the problem. This approach has both theoretical and implementation benefits compared to the current FC model. After discussion, this approach is not being proposed at this time due to potential difficulties with updating the FC builder, viewers and other applications under development that use the current S-100 FC model.

Conclusion

At this time, only clarifications to S-100 Edition 4.0.0 Part 5 should be applied for S-100 Edition 5.0.0. Updates to the feature catalogue model should be tabled for action for a later edition of S-100. Feature catalogues for product specifications should be reviewed to change the roles in feature bindings in accordance with this paper.

The feature catalogue builder should be checked to ensure that feature catalogues can be created in accordance with the proposed clarifications.

Recommendations

- (1) Feature catalogues that include feature associations should be reviewed and corrected if necessary. DCEGs will also need to be updated.
- (2) S-100 5-4.2.5.2 (Feature Bindings) and S-100 5-4.2.5.3 (Information Bindings) should be clarified to ensure that product specification developers know how to encode role types in feature catalogues and DCEGs.
- (3) S-100 4.0.0 Table 5-A-19 should be revised to ensure that associations are not confused with their **ends** (“roles”). This would involve revising the definitions for S100_FC_RoleType literals.
- (4) S-100 should use the role type literals in a way that is consistent with UML instead of reversing the meanings for the purposes of feature catalogues.

- (5) The functioning of the feature catalogue builder should be checked to ensure it can construct feature catalogues consistent with the proposed clarifications.

Actions Requested

The S-100 WG is invited to:

- Endorse the recommendations of this paper
- Endorse the accompanying S-100 maintenance proposal.