

Paper for Consideration by TSMAD and DIPWG

Modification of the General Feature Model

Motivation:

The motivation for the change in the general feature model was to increase flexibility for associations. This applies to associations between feature types as well as for associations between information types and feature types or other information types.

Background:

The GFM in S-100 Version 1.0.0 does not allow to associate information types by means of association types. In addition the feature association types are not allowed to carry thematic attributes. Both are required for the modeling of nautical publications. Since workarounds were not satisfying the situation it was discussed to alter the GFM to achieve the requirements. This document proposes the necessary changes to the GFM.

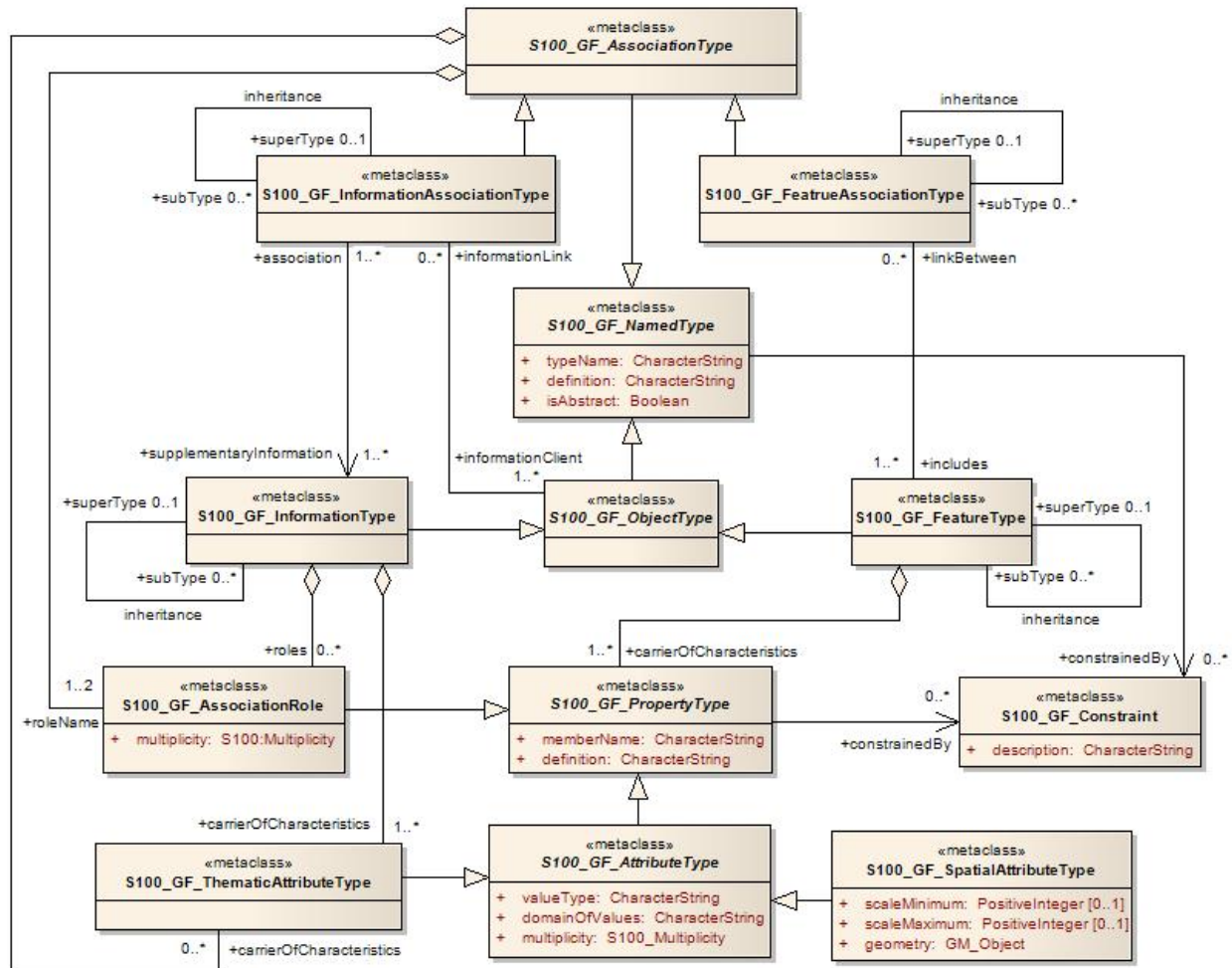
These changes will have side effects to other parts of the S-100 standards especially the feature catalogue model and schema as well as the data encapsulation. These changes will be proposed in a separate document.

Proposed changes (brief):

The main changes are:

- Subclass **S100_GF_AssociationType** from Named Type.
This should indicate that associations are identifiable structures as feature or information types.
Association can carry thematic attributes and have roles.
- There are two classes derived from **S100_GF_AssociationType**:
S100_GF_FeatureAssociationType and **S100_GF_InformationAssociationType**.
The motivation for this is to indicate the different semantics of the two kinds of associations.
Feature associations describe the relationship between two feature types where information associations describe the association between a feature or information type and an information type that carries additional information for the client.
- The two classes for roles are combined into one: **S100_GF_AssociationRole**.
Since we have now two classes for the different association the role only describes the end of those associations. This was the originally intended of having roles.
- A class **S100_GF_ObjectType** is introduced in the model. It is the parent class of feature and information types and describes the set of types that can act as an information client in an information association.

Proposed changes (detailed):



Excerpt from the modified GFM

Elements of the model:

S100_GF_NamedType

The class S100_GF_NamedType is not realised from ISO 19109 but is introduced specifically for the S-100 GFM. It is an abstract super-class of the classes S100_GF_ObjectType and S100_GF_AssociationType. The intention in introducing this class is to show the commonality between object types and association types within S-100. These types are core identifiable objects of S-100 data schemas.

Role Name	Name	Description	Mult.	Type
Class	S100_GF_NamedType	Abstract base class for object types and association types within the GFM.	-	-

Attribute	typeName	Name of the named type. The name shall be unique within a namespace.	1	CharacterString
Attribute	definition	Definition that describes the named type.	1	CharacterString
Attribute	isAbstract	If true, the named type acts as an abstract supertype. It is not possible to create an instance of an abstract type	1	Boolean
Role	constrainedBy	The role specifies that a constraint is made on the named type.	0..*	S100_GF_Constraint

S100_GF_ObjectType

The class S100_GF_ObjectType is not realised from ISO 19109 but is introduced specifically for the S-100 GFM. It is an abstract super-class of the classes S100_GF_FeatureType and S100_GF_InformationType. The intention in introducing this class is to show the commonality between feature types and information types in particular the ability of these classes to be linked to information types by means of a information association.

Role Name	Name	Description	Mult.	Type
Class	S100_GF_ObjectType	Abstract base class for object types within the GFM.	-	-
Role	informationLink	Link to an information association that describes the relationship to an instance of an information type.	0..*	S100_GF_InformationAssociationType

S100_GF_AssociationType

The class S100_GF_AssociationType is the S-100 realisation of the ISO 19109 class GF_AssociationType. It differs from the ISO 19109 class in the following way:

- 1) The ISO 19109 GFM models GF_AssociationType as a subtype of the class GF_FeatureType. This is done for reasons which are set out in Note 1 of ISO 19109 clause 7.3.9. The S-100 model model the class as a subtype of S100_GF_NamedType. Within S-100 associations between feature types are not considered abstractions of real world phenomena. The result of this approach to modelling the GFM is that the only properties associations can have are thematic attributes.

Role Name	Name	Description	Mult.	Type
Class	S100_GF_AssociationType	Abstract base class for feature associations and information associations	-	-
Role	carrierOfCharacteristics	The thematic attributes that describes the association.	0..*	S100_GF_ThematicAttributeType
Role	roleName	The roles that describes the ends of the association	1..2	S100_GF_AssociationRole

S100_GF_FeatureType

The class S100_GF_FeatureType is a realisation of the ISO 19109 class GF_FeatureType. It differs from the ISO class in the following ways:

1. It is a sub-type of the class S100_GF_ObjectType;

2. It does not realise the Generalization and Specialization associations with the class GF_InheritanceRelation. Instead, the class has an association with itself with the roles subType and superType. GF_InheritanceRelation is not realised in the S-100 GFM;
3. The multiplicity of the superType is 0..1 to represent the concept that a feature may have a maximum of one superType. This is in order to prevent multiple-inheritance in S-100;
4. The multiplicity of the role carrierOfCharacteristics with S100_GF_PropertyType (the S-100 realisation of GF_PropertyType) is changed from 0..* to 1..*. An S-100 feature must have properties.

Role Name	Name	Description	Mult.	Type
Class	S100_GF_FeatureType	A type for an abstract representation of a real world phenomenon.	-	-
Role	superType	The more generic feature type from which this feature type is derived.	0..1	S100_GF_FeatureType
Role	subType	The more specific feature types which are derived from this feature type.	0..*	S100_GF_FeatureType
Role	linkBetween	A link to a feature association that specify the relationship between one feature type and the same or another feature type.	0..*	S100_GF_FeatureAssociationType
Role	carrierOfCharacteristics	Attributes and roles that describe the characteristics of a feature type.	1..*	S100_GF_PropertyType

S100_GF_InformationType

S100_GF_InformationType is the class for information types within S-100. An information type is an identifiable object that can be associated with features in order to carry information particular to the associated features. An example of an information type might be a Chart Note. Information types can also be associated with each other. This could be done where there is further supplementary information that is relevant to the information type or where there is a need to translate the information. For example a primary information object carrying a Chart Note may contain text in English and an associated supplementary information object may carry the same text in German. The characteristics of information types shall be carried by thematic attribute types only. Therefore, S100_GF_InformationType is associated with only S100_GF_ThematicAttributeType rather than the more generic class S100_GF_PropertyType. The associations to information types are modeled by means of the type S100_InformationAssociationType.

Role Name	Name	Description	Mult.	Type
Class	S100_GF_InformationType	A type for an identifiable object carrying supplementary information for other objects.	-	-
Role	superType	The more generic information type from which this information type is derived.	0..1	S100_GF_InformationType
Role	subType	The more specific information types which are derived from this information type.	0..*	S100_GF_InformationType
Role	association	A link to an information association that specifies the relationship between one object type and this information type.	0..*	S100_GF_InformationAssociationType
Role	carrierOfCharacteristics	Thematic attributes that describe the characteristics of an information type.	1..*	S100_GF_ThematicAttributeType

Role	roles	Roles for associations to other information type that supplying supplementary information.	0..*	S100_GF_AssociationRole
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S100_GF_FeatureAssociationType

The class S100_GF_FeatureAssociationType is not realised from ISO 19109 but is introduced specifically for the S-100 GFM. The reason for this is that in S-100 two types of associations are distinguished: feature associations and information associations. They are both semantically different and different in the model. This class describes the feature association. A feature association is the description of the relationship between two instances of feature types. It can be characterized by thematic attributes and has normally two roles. The roles describe the ends of the relationship since such relationship is usually not symmetric.

Role Name	Name	Description	Mult.	Type
Class	S100_GF_FeatureAssociationType	A class for the description of a relationship between two feature types.	-	-
Role	superType	The more generic feature association from which this feature association is derived.	0..1	S100_GF_FeatureAssociationType
Role	subType	The more specific feature associations which are derived from this feature association.	0..*	S100_GF_FeatureAssociationType
Role	includes	The feature types which are included in this relationship.	1..*	S100_GF_FeatureType

S100_GF_InformationAssociation

The class S100_GF_InformationAssociationType is not realised from ISO 19109 but is introduced specifically for the S-100 GFM. The reason for this is that in S-100 two types of associations are distinguished: feature associations and information associations. They are both semantically different and different in the model. This class describes the information association. An information association is the description of the relationship between an arbitrary object and an information type that supplies additional information for that object. The relationship can be characterized by thematic attributes and a role.

Role Name	Name	Description	Mult.	Type
Class	S100_GF_InformationAssociationType	A class for the description of a relationship between an object and an information type.	-	-
Role	superType	The more generic information association from which this information association is derived.	0..1	S100_GF_InformationAssociationType
Role	subType	The more specific feature associations which are derived from this feature association.	0..*	S100_GF_InformationAssociationType
Role	supplementaryInformation	The information type that supplies the additional information.	1..*	S100_GF_InformationType
Role	informationClient	The object types that act as client in the information association	1..*	S100_GF_ObjectType

S100_GF_PropertyType

The class S100_GF_PropertyType is a realisation of the ISO 19109 class GF_PropertyType. It differs from the ISO class in the following ways:

1. The multiplicity of the association with S100_GF_FeatureType is changed from 1 to 1..*. This change represents the way that features and properties are described in the S-100 Feature Catalogue. Property type definitions can be used in one or more feature type definitions;
2. The association type of the association with S100_GF_FeatureType is changed from composition to aggregation as a result of the change in multiplicity described above.

Role Name	Name	Description	Mult.	Type
Class	S100_GF_PropertyType	Abstract base class for all properties of a feature type. These are attributes and roles.	-	-
Attribute	memberName	Name of the attribute or role.	1	CharacterString
Attribute	definition	Description of the attribute or role of the feature type.	1	CharacterString
Role	constrainedBy	The role specifies that a constraint is made on the property	0..*	S100_GF_Constraint

S100_GF_AssociationRole

The class S100_GF_AssociationRole is the S-100 realisation of the ISO 19109 class GF_AssociationRole.

Role Name	Name	Description	Mult.	Type
Class	S100_GF_AssociationRole	A role used in an association	-	-
Attribute	multiplicity	The number of objects the may be associated within the association.	1	S100_Multiplicity

S100_GF_AttributeType

The class S100_GF_AttributeType is the S-100 realisation of GF_AttributeType. It is largely identical to the ISO 19109 class but differs in the following way:

- 1) The association attributeOfAttribute is not realised in the S-100 GFM. S-100 introduces, instead, the concept of complex attributes. Complex attributes are described further in ISO 19109 subclause 7.4

Role Name	Name	Description	Mult.	Type
Class	S100_GF_AttributeType	Abstract base class for all attributes of feature types. In this model are two sub classes: thematic attributes and spatial attributes.	-	-
Attribute	valueType	The data type of the attribute value.	1	CharacterString
Attribute	domainOfValues	Description of a set of values.	1	CharacterString
Attribute	multiplicity	The number of instances of the attribute that may be associated with a single instance of a feature type	1	S100_Multiplicity

S100_GF_ThematicAttributes

The class S100_GF_ThematicAttributeType is a realisation of the ISO 19109 class GF_ThematicAttributeType. Thematic attribute types carry descriptive characteristics of objects other than those specified in ISO 19109 clauses 7.4.3 – 7.4.7. This class differs from the ISO 19109 class in the following ways:

- 1) GF_ThematicAttributeType is defined in ISO 19109 as a concrete class. The S-100 GFM realisation is an abstract class with two concrete subclasses – S100_GF_SimpleAttributeType and S100_GF_ComplexAttributeType.
- 2) Temporal information shall have their value type defined by the types Date, Time, DateTime or complex structures using combinations of the primitive temporal types.

Role Name	Name	Description	Mult.	Type
Class	S100_GF_ThematicAttributeType	Abstract base class for all attributes other than spatial attributes.	-	-

S100_GF_SpatialAttributeType

The class S100_GF_SpatialAttributeType is a realisation of the ISO 19109 class GF_SpatialAttributeType. A spatial attribute type shall have a GM_Object as its value type. GM_Object and its sub-types are defined in the Spatial Schema, S-100 Part 7.

Role Name	Name	Description	Mult.	Type
Class	S100_GF_SpatialAttributeType	Class representing a spatial attribute, which shall be used to express spatial characteristics of a feature type.	-	-
Attribute	scaleMinimum	The smallest denominator of a scale for that an instance of a feature type shall be used (e.g. for portrayal)	0..1	PositiveInteger
Attribute	scaleMaximum	The largest denominator of a scale for that an instance of a feature type shall be used (e.g. for portrayal)	0..1	PositiveInteger
Attribute	geometry	The object that describes the geometry of an instance of a feature type.	1	GM_Object

S100_GF_Constraint

The class S100_GF_Constraint is a realisation of the ISO 19109 class GF_Constraint with an association to S100_GF_NamedType instead of the ISO 19109 association to GF_Feature_Type.

Role Name	Name	Description	Mult.	Type
Class	S100_GF_Constraint	Class for constraints that may be associated with named types or their properties.	-	-
Attribute	description	The constraint described in natural language and/or in formal notation.	1	CharacterString