S-100 GML Format Way Forward

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S-100 WG 6

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(slightly) updated for NIPWG VTC December 2022

MAIN TECHNICAL IDEAS

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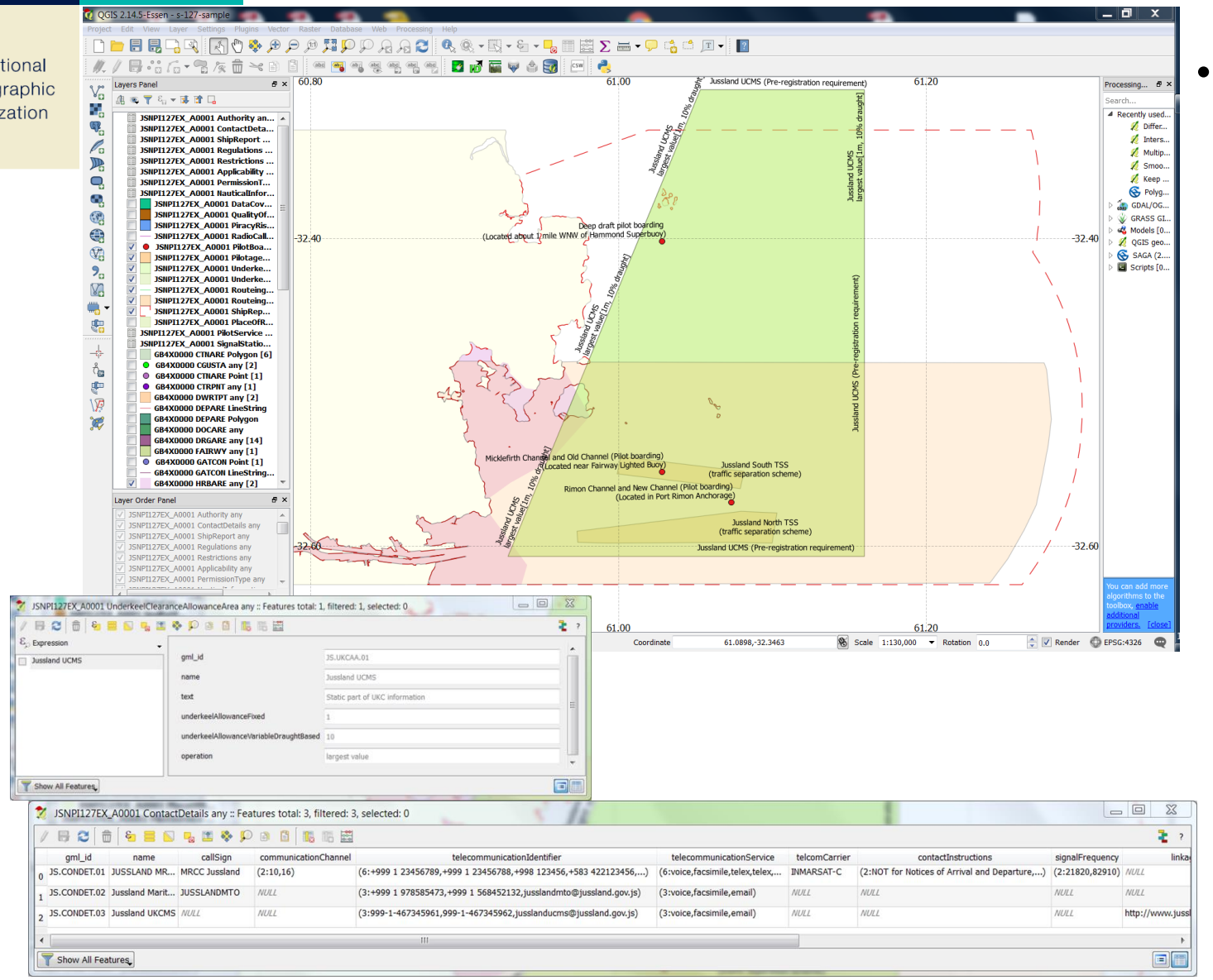
Reduce to widely used GML constructs	• Use standard GML mappings • Drop S-100 variations to ISO GFM and Geometry
Adopt best practices from S-122, S-123, S-127, S-121	• Rationalize spatial types • Drop 1/1 mapping to ISO 8211 format • Reduce number of options
Relationship to FC and Application Schema UML	• Expand description of mapping to feature catalogue
Software libraries	• Use GML-specific off-the-shelf libraries, generic XML libraries may involve a lot more work for GML
Solution strategies	• Generate code classes – if needed – from FC • Adopt generic strategy for ingest • Leverage XSLT and Schematron to reduce effort
S-100 Developer Resources	• S1OOP Wiki • Other common resources?

QGIS - S-127 SAMPLE DATASET



- The QGIS data ingest strategy works with S-122, S-123, and S-127 sample datasets that conform to the Ed. 4.0 GML profile.
  - Loads both feature and information types.
  - Product-specific GML schema is not needed by QGIS – all it needs to know that it is a GML 3.2 file.
  - Can ingest all information except for S-100's special extensions to the ISO 19109 model and GML (e.g., multiple spatial attributes in a feature instance, associations, scale attributes on spatial types).

PROPOSED PLAN

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1921–2021

Update Part 10b for Ed. 5.0.0

- Firm up technical ideas to be applied to the revision
- Discuss revisions on GitHub + VTCs as needed

Update GML profile

Common resources and best practices for solutions

- Document on S1OOP Wiki
- Common resources? TBD.

Use S-131 (Marine Harbour Infrastructure) as a testing ground.

- S-131 is currently under development.
- Confirm with NIPWG.

Github discussion - 6.11 Revision of GML Annex #23: https://github.com/IHO-S100WG/TSM8/issues/23

Supplementary Slides Technical Details

The following slides are for information only

Discussion & further development of details can continue on the GitHub site mentioned on the previous slide or by VTC

USE ‘WELL-KNOWN’ GML CONSTRUCTS

- Use UML ↔ GML mappings as specified by the GML standard, e.g., *Real* ↔ *xsd:double*.
- Drop implementations of S-100 variations of the ISO 19109 GFM.
  - The GML specifications implement ISO 19109, and common GML software is written accordingly. Processing S-100’s variations requires customizations or extensions.
- Examples ... and exceptions:
  - Drop scale ranges on spatial attributes – create a copy of the feature instance instead.
    - Modeling solution exists – defining scale ranges as feature attributes.
  - Disallow multi-valued geometry on feature instances – create copies each with a single-valued location.
    - Modeling solution can be defined to aggregate such copies, or to avoid duplication of thematic attributes.
    - Multi-points still OK.
    - Different feature instances can still use different types of spatial primitives (point for one, surface for another).
  - Implement information types as derived from gml:AbstractFeature, like feature types.
  - Circle and arc – implement as standard GML types.
  - Masking – one ‘extension’ S-100 probably needs to retain – because ‘common’ GML does not include it.

SIMPLIFY & STANDARDIZE ON COMMON PRACTICE

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- Rationalize spatial types
  - Simplify encoding of surfaces (e.g., gml:polygon, with interpolation none or planar? Cf. S-100 § 7-4.2.3).
  - Encode geometry inline in a feature instance, instead of a separate spatial object.
    - Solution for shared geometry TBD – perhaps inline in one feature, referenced by other features?
  - Topology implementation (Node/TopoPoint, Edge/TopoCurve, Face/TopoFace) TBD, depending on validation requirements. (But “S-100 Part 7 explicitly excludes topological primitives” - S-100 § 3-6.5.1).
- Drop the old design principle of 1/1 mapping between GML and ISO 8211 formats.
  - In the last 7 years, nobody has asked about inter-conversion.
- Associations should be named properties of features instead of generic featureAssociation & informationAssociation (retain 10b-9.5.2, drop 10b-9.5.1 (*ed. 4.0 clause numbers*)).
  - This (associations as named properties) has been added in S-100 5.0.
  - There are still problems with the association class encoding concept in Edition 5.0 (after Figure 10b-3). A maintainance proposal with a temporary bypass has been submitted to the S-100 WG. There will be follow-up, planned for the next S-100 TSM.
- Etc.

Association class encoding

S-100 5.0 Clause 10b-8.4.1

10b-8.4 Associations

The profile allows associations to be encoded inline or by reference. The dataset metadata field associationEncoding shall be defined as either "reference" or "inline" to define which method is used throughout conforming datasets. In addition to the dataset metadata constraint such associations shall only be used to express composition relationships defined by the corresponding Feature Catalogue.

For bi-directional associations, the profile supports the optional encoding of the name of reverse property in the *appInfo* annotation element in the Application Schema XSD.

10b-8.4.1 Association classes

The profile allows the GML 3.3 convention for encoding of association classes using the GML 3.3 association class conversion rule, which converts association classes to an equivalent intermediate class. The figures below illustrate the conversion rule.

Where associations contain attributes in a Product Specification Feature Catalogue, this structure shall be used to realise those attributes via an intermediate Information Type. The name of the Information Type shall be defined as the name (S100_FC_Item code) of the relationship (either feature or information association) concatenated with "Type" and is not required to be defined within the Feature Catalogue.

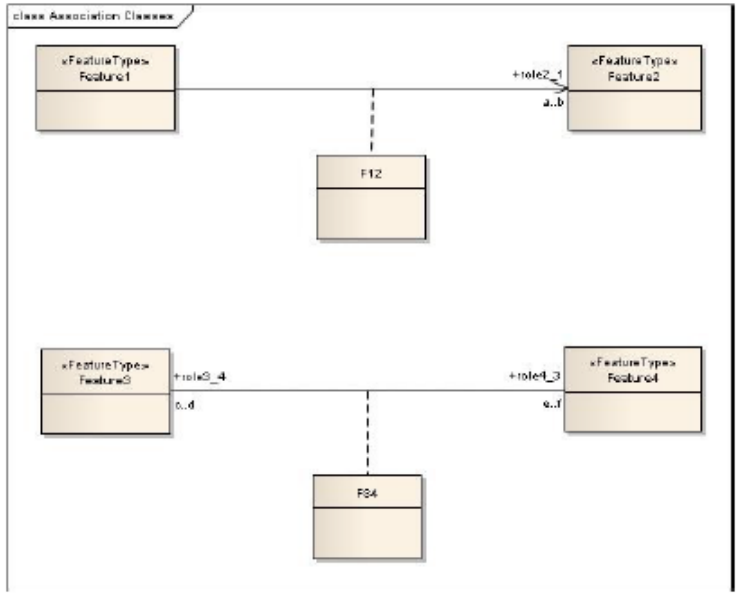

Figure 10b-2 – Model with association classes (from OGC 10-129r1 / ISO 19136-2:2015)

An example (taken from S-127) is shown in Figure 10b-3 below. Here an association class "PermissionType", corresponding to a relationship with code "Permission", is used to express the association attribute "categoryOfRelationship".

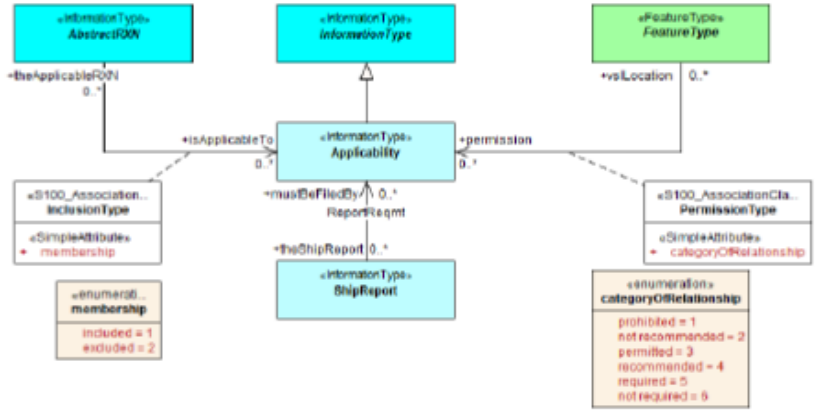

Figure 10b-3 – Example use to represent attributes of associations (S-127)

To avoid needless duplication of relationships between source/destination features and the intermediate information types, the intermediate information type shall be included inline with the referencing feature; for example:

```
<S-127:VesselTrafficServiceArea gml:id="a1">
  <categoryOfCargo>ballast</categoryOfCargo>
  <theApplicableRxN xlink:href="#R1">
    <S-127:PermissionType gml:id="res1">
      <categoryOfRelationship>required</categoryOfRelationship>
    </S-127:PermissionType>
  </theApplicableRxN>
</S-127:VesselTrafficServiceArea>
<S-127:Restrictions gml:id="R1">
  <categoryOfAuthority>coast guard</categoryOfAuthority>
</S-127:Restrictions>
```

In the Application Schema this shall be done by extension of gmlReferenceType.

```
<xs:complexType name="PermissionType">
  <xs:sequence>
    <xs:element name="categoryOfRelationship" type="categoryOfRelationshipType" minOccurs="1"
    maxOccurs="1"/>
  </xs:sequence>
</xs:complexType>
        <xs:complexType name="theApplicableRxN">
                <xs:complexContent>
                        <xs:extension base="gml:ReferenceType">
                                <xs:sequence>
            <xs:element name="PermissionType" type="PermissionType" minOccurs="1"
            maxOccurs="1"/>
                                </xs:sequence>
                        </xs:extension>
                </xs:complexContent>
        </xs:complexType>
```

RELATIONSHIP TO GFM AND APPLICATION SCHEMAS

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- The mapping between feature catalogue and GML datasets is described in 10b-14.
  - Camel case codes of features, information types, attributes as the 'local name' in XML tags. *Retain.*
  - Enumeration & codelists:
    - Numeric code, label, or alias. *Disallow alias*.
    - Dataset header – *attributeEncoding* field to indicate which is used. *Define in GML profile XSD*.
  - Features, information types, simple & complex attributes in FC → simple or complex types in XSD. *Current practice becomes a formal requirement.*
    - *Feature-specific limitations on enumeration values – TBD. Could be Schematron constraints (cf. S-127 1.0.0), inline restriction types, XSLT constraints, or derived types in the XSD (the last would cause lots of type proliferation in GML application schemas).*
  - Spatial objects must be encoded inline in some feature – new requirement.
  - Feature and information associations: Role name as tag - 10b-9.5.2 only. *Remove 10b-9-5.1 (generic "featureAssociation" and "informationAssociation" tags).*

Most of the recommendations on this page have since been incorporated into S-100 Edition 5.0

SUPPORT FOR SOFTWARE AND S-100 SOLUTION STRATEGIES

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- GML-specific libraries should be used, generic XML libraries are less useful.
  - Reported difficulties with using .NET XML Schema Definition Tool (*xsd.exe*) to generate classes.
  - Consider generating classes from feature catalogue instead – if classes are needed.
  - However, compliance with the GML standard means custom software for each product specification is not necessary.
    - QGIS can load GML data that complies with S-100 Part 10b and display its feature classes as layers, like other geographic data. This works with S-122, S-123, and S-127 sample data files.
      - The only knowledge QGIS needed is that it is reading GML 3.2 data. The product-specific application schema is not needed!
      - S-100-specific constructs (e.g., multiple spatial attributes in an instance, feature and information associations, complex attributes) are ignored or simplified by QGIS, but features, information types, feature geometry, and attributes and their values are read treated like other data formats.
    - Conversion to a common format is also possible using the conventions in §10b-15.

CONCLUSION

- Use S-131 as a testbed for exploring the feasibility and interoperability of the Edition 5.0 Part 10b GML encoding.
- Refine and elaborate the concepts described here to make the S-100 GML encoding more compatible with general practice after more practical experience has been gained using S-131 data.