**Paper for Consideration by TSMAD28/DIPWG6**

**[Portrayal Model Extension for Coverage Data]**

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| ***Submitted by:*** | CARIS |
| ***Executive Summary:*** | Discussion on addition of Coverage Portrayal to S-100 Part 9 |
| ***Related Documents:*** | S-100 Part 9, |
| ***Related Projects:*** | S-100 Part 9 |

# Introduction / Background

In the last distributed S-100 Part 9 draft, a placeholder was left for Coverage Portrayal. This document describes the proposal for an initial portrayal coverage implementation.

# Analysis/Discussion

*"A coverage is a feature that has multiple values for each attribute type, where each direct position within the geometric representation of the feature has a single value for each attribute type." [ISO 19123:2005, Introduction]*

The proposed coverage portrayal allows a continuous coverage to be coloured based on one of the coverage attribute values. For example a depth coverage could be coloured by depth range intervals. The colouring can also be applied using colour interpolation or a ramp of colours applied to a range of values to give a gradient effect.

A coverage can also be filled with Numeric annotations or symbols.

**Coverage Fill**
An instruction to portray data coverages like gridded bathymetry, satellite images, etc.
Coverage attributes used for portrayal are expected to have numeric values.

The assignment of Portrayal for a Coverage starts with a Coverage Feature. Like other Feature types a rule (XSLT template) is used to match the Feature to Drawing instructions.
A first match lookup table is used to assign portrayal based on a specified coverage attribute. There are three options for coverage portrayal, filling with colour, annotating with numeric text or annotating with symbols.

**Colour assignment**
Colours are applied to a coverage by using a lookup table that matches a selected attribute value and specifies a colour. For a continuous coverage such as grid cells, pixels or tiles then each element is processed and colour filled with the appropriate colour. For a discrete coverage with distinct points colour is applied as a Pen Down or dott operation using the assigned pen width.

A lookup table entry can match a range of values and assign a single colour to that range or specify a start and end colour that is used to create a gradient or ramp effect as a linear interpolation of the value range across the colour range.

**Numeric and Symbol Annotations**
For a continuous coverage the centre of each cell (e.g. rectangle, tile, triangle) is used as the anchor point of the text or symbol.
For numeric annotations, overplot removal or collision avoidance is expected. A buffer can be used to provide some space between the annotations. A buffer of 0 means that direct overplot is used when digits interact. An enumeration called 'champion' is used to specify which annotation to keep (largest or smallest value) when an interaction occurs. For numeric annotations the text shall be placed such that the optical/geometric centre of the text represents the location.

For symbol annotations separate attributes from the coverage can be used to apply a scaling and rotation to the symbol. This can be useful for example when portraying a coverage that carries wave height and direction.

### Ranges

Ranges are used to control how portrayal is assigned to the values in a Coverage. These make use of the S-100_NumericRange complex type which is defined in S-100 Part 1 Conceptual Schema Language. The Numeric Range type allows for various range definitions with different closure options.

### Lookup Table

The CoverageFill class carries and ordered list of lookup entries. Each of these entries carries a range used to evaluate a match by testing if the coverage value matches the range. The first lookup entry with a matching range is used to apply up to one of each type of portrayal (colour, numeric annotation or a symbol) to the coverage element. This allows for example to fill a cell in a grid with a colour and assign a numeric or symbol annotation to the cell as well.

### Model

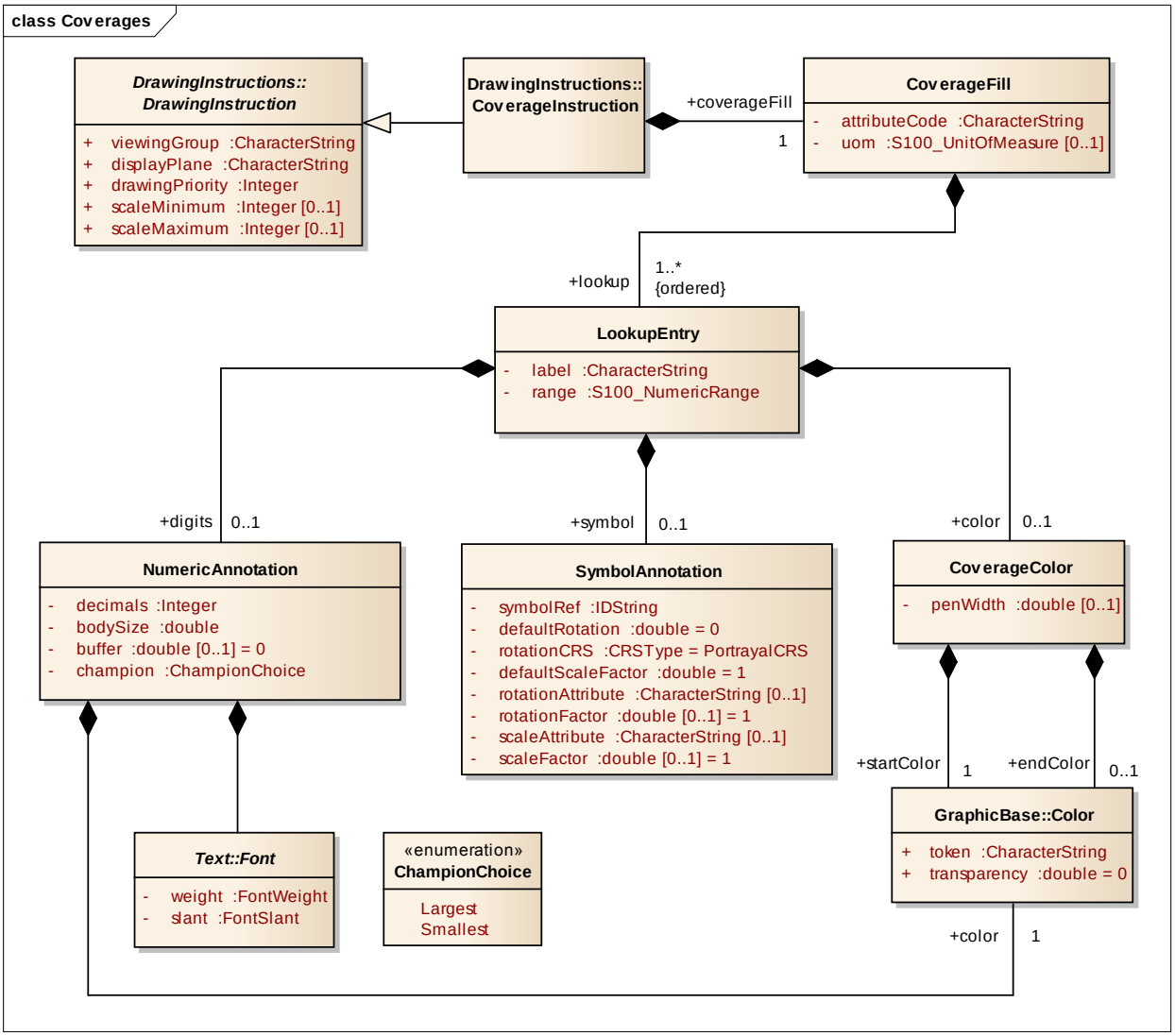


Figure 1 Coverage Package

## CoverageFill

| Role Name | Name | Description | Mult. | Type |
|---|---|---|---|---|
| Class | CoverageFill | A class to fill a Coverage with using a lookup table to match a value or range of values and assign colour, numeric or symbol annotations. | - | - |
| Attribute | attributeCode | Code of coverage attribute value to match. | 1 | CharacterString |
| Attribute | uom | Unit of measure. If not given the values in the range are assumed to be same units as the coverage attribute values. | 0..1 | S100_UnitOfMeasure |

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|---|---|---|---|---|
| Role | lookup | Lookup table. The entries are ordered and processed on a first match basis. | 1..* | LookupEntry |

## LookupEntry

| Role Name | Name | Description | Mult. | Type |
|---|---|---|---|---|
| Class | LookupEntry | An entry in a lookup table used to assign portrayal to coverage elements. | - | - |
| Attribute | label | String used as a display label or legend field. | 1 | CharacterString |
| Attribute | range | Value range definition. Can be a single value, open or closed range etc. See S-100 Part 1 Conceptual Schema Language for details. | 1 | S100_NumericRange |
| Role | color | The color to assign to the matching range. Can be a single color or a color ramp. | 0..1 | CoverageColor |
| Role | digits | Display the value as numeric digits. | 0..1 | NumericAnnotation |
| Role | symbol | Display a symbol. | 0..1 | SymbolAnnotation |

## CoverageColor

| Role Name | Name | Description | Mult. | Type |
|---|---|---|---|---|
| Class | CoverageColor | A class to fill a Coverage with color | - | - |
| Attribute | penWidth | Optional pen width to apply for dot color used for discrete points. | 0..1 | double |
| Role | startColor | The color to assign to the matching range or to use as start point in a color ramp when 'endColor' is defined. | 1 | GraphicBase::Color |
| Role | endColor | The color to use as stop point in a color ramp. The range of values is spread linearly across the range of colors from 'startColor' to 'endColor' to produce a gradient effect. | 0..1 | GraphicBase::Color |

## NumericAnnotation

| Role Name | Name | Description | Mult. | Type |
|---|---|---|---|---|
| Class | NumericAnnotation | A class for numeric textual annotations of values in a Coverage. | - | - |
| Attribute | decimals | Number of decimal digits to show in subscript. | 1 | Integer |
| Attribute | bodySize | This property describes the size with which the text will be depicted. | 1 | double |
| Attribute | buffer | Buffer to apply for collision detection in presentation units. Default=0 | 1 | double |
| Attribute | champion | Enumeration to indicate which value to display in the event of a collision. | 1 | ChampionChoice |
| Role | font | Font information to use for display of numeric values across a coverage. Text::Font is a choice of either FontCharacteristics or FontReference. | 1 | Text::Font |
| Role | color | Color to draw the numeric annotation. | 1 | GraphicBase::Color |

## SymbolAnnotation

| Role Name | Name | Description | Mult. | Type |
|---|---|---|---|---|
| Class | SymbolAnnotation | A class for symbol annotations of values in a coverage. | - | - |
| Attribute | symbolRef | Reference to the symbol to apply. Catalogue id. | 1 | IDString |
| Attribute | defaultRotation | A default symbol rotation. Applies when rotation attribute not defined. Default=0 | 0..1 | double |
| Attribute | rotationCRS | Specifies the coordinate reference system for the rotation. Default=PortrayalCRS | 1 | GraphicsBase::CRSType |
| Attribute | defaultScale | A default symbol scale factor. Applies when scale attribute not defined. Default=1 | 1 | double |
| Attribute | rotationAttribute | The attribute code of the Coverage Attribute to use for the symbol rotation value. | 0..1 | CharacterString |
| Attribute | rotationFactor | Used to adjust the 'rotationAttribute' value by multiplication before applying. Default 1.0 | 0..1 | double |

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|---|---|---|---|---|
| Attribute | scaleAttribute | The attribute code of the Coverage attribute to use for scaling the symbol size. | 0..1 | CharacterString |
| Attribute | scaleFactor | Used to adjust the ‘ scaleAttribute’ value by multiplication before applying. Default 1.0 | 0..1 | double |

**Extract of Coverage fill schema definition**

```
<!-- THE COVERAGE  PACKAGE -->
    <!-- Enumeration ChampionChoice -->
    <xs:simpleType name="ChampionChoice">
        <xs:restriction base="xs:string">
            <xs:enumeration value="Smallest"/>
            <xs:enumeration value="Largest"/>
        </xs:restriction>
    </xs:simpleType>

    <!-- Class CoverageColor -->
    <xs:complexType name="CoverageColor">
        <xs:sequence>
            <xs:element name="startColor" type="Color" />
            <xs:element name="endColor" type="Color" minOccurs="0" maxOccurs="1"/>
        </xs:sequence>
        <xs:attribute name="penWidth" type="xs:double" />
    </xs:complexType>

        <!-- Class NumericAnnotation -->
    <xs:complexType name="NumericAnnotation">
        <xs:sequence>
            <xs:group ref="Font"/>
            <xs:element name="color" type="Color" />
        </xs:sequence>
        <xs:attribute name="decimals" type="xs:int" default="1"/>
        <xs:attribute name="bodySize" type="xs:double" use="required"/>
        <xs:attribute name="buffer" type="xs:double" default="0"/>
        <xs:attribute name="champion" type="ChampionChoice" default="Smallest"/>
    </xs:complexType>

        <!-- Class SymbolAnnotation -->
    <xs:complexType name="SymbolAnnotation">
        <xs:sequence>
            <xs:element name="rotationAttribute" type="xs:string" minOccurs="0" maxOccurs="1" />
            <xs:element name="rotationFactor" type="xs:double" minOccurs="0" maxOccurs="1"/>
            <xs:element name="scaleAttribute" type="xs:string" minOccurs="0" maxOccurs="1" />
            <xs:element name="scaleFactor" type="xs:double" minOccurs="0" maxOccurs="1"/>
        </xs:sequence>
        <xs:attribute name="reference" type="IdString" use="required"/>
        <xs:attribute name="defaultRotation" type="xs:double" default="0.0"/>
        <xs:attribute name="rotationCRS" type="CRSType" default="PortrayalCRS"/>
        <xs:attribute name="defaultScaleFactor" type="xs:double" default="1.0"/>
    </xs:complexType>

        <!-- Class LookupEntry -->
    <xs:complexType name="LookupEntry">
        <xs:sequence>
            <xs:element name="label" type="xs:string"/>
            <xs:element name="range" type="s100CSL:S100_NumericRange" minOccurs="0"
maxOccurs="1"/>
            <xs:element name="color" type="CoverageColor" minOccurs="0" maxOccurs="1"/>
            <xs:element name="digits" type="NumericAnnotation" minOccurs="0" maxOccurs="1"/>
            <xs:element name="symbol" type="SymbolAnnotation" minOccurs="0" maxOccurs="1"/>
        </xs:sequence>
    </xs:complexType>

        <!-- Class CoverageFill -->
    <xs:complexType name="CoverageFill">
        <xs:sequence>
```

```
            <xs:element name="attributeCode" type="xs:string"/>
            <xs:element name="uom" type="s100CSL:S100_UnitOfMeasure" minOccurs="0"
maxOccurs="1"/>
            <xs:element name="lookup" type="LookupEntry" minOccurs="1" maxOccurs="unbounded"/>
        </xs:sequence>
    </xs:complexType>
```

# Conclusions

This should provide a basic coverage portrayal capability. The above Coverage portrayal model and documentation has already been included in the new baseline S-100 Part 9 document under TSMAD28_DIPWG6 11.1A.

# Recommendations

Review coverage portrayal and test how it can be applied to sample data.

# Justification and Impacts

This should provide a basic coverage portrayal and help complete S-100 Part 9 to cover all the datatypes defined in S-100.

# Action Required of DIPWG

The DIPWG is invited to:

a. Review the proposed coverage portrayal model and recommend improvements.