

SPAWAR S-100 Testbed Project

1 GENERAL INFORMATION

- **Name of testbed:** SPAWAR S100 Testbed Program
- **Location of testbed:** Norfolk, Virginia
- **Time and duration of testbed:** Ongoing through Phase 6 (Shore Based ECDIS)
- **Contact person(s):** Robert Greer, Robert.a.greer@navy.mil (Project Manager); Mikan Stamenkovich, mikan.stamenkovich@navy.mil (Technical Lead)
- **Testbed website:** N/A
- **Organization(s) involved:** SPAWAR Systems Center Atlantic
- **Last Edited/Updated:** March 14, 2018

2 EXECUTIVE SUMMARY

The SPAWAR S-100 Testbed Project aims to provide empirical proof of the S-100 design through phased implementation of an ECDIS. The testbed will implement data import and validation, data loading and portrayal of S-100 derived data products in the context of a Simple Viewer (Phase 3) and Shore Based ECDIS (Phase 6).

In order to support development through Phase 6 various elements of the S-100 Testbed initiative are exercised by the SPAWAR testbed project. Testing areas include Phase 1 (Feature and Portrayal Catalogue use), Phase 2 (validation of S-101 converted data and S-100 based portrayal). After Phase 3 completes, additional testing during Phases 4 and 5 will be used to support the Shore Based ECDIS development of Phase 6.

3 TESTBED INFORMATION

The primary users are S-100 Working Group members and other interested IHO parties. The testbed aims to identify gaps in utilization of the S-100 family of product specifications with initial focus on S-100 and S-101. Support for products using GML and HDF-5 encodings will follow.

The S-100 testbed phases implemented to date are:

- Build Catalogues (Phase 1)
- Produce data (Phase 2)
- Ingest and Display Data on ECDIS (Phase 3 Simple Viewer)

The category of S-100 Testbed solutions considered in the SPAWAR testbed project were both technical validation of the specifications and operational considerations in the context of ECDIS.

4 TESTBED METHODOLOGY

4.1 METHODOLOGY USED FOR DATA COLLECTION:

Ongoing development efforts for Phase 3 will be presented in this report. As our testbed matures, additional reporting for phases beyond 3 will be included, e.g. Phase 6 (Shore Based ECDIS).

Methodology used for data collection involves sharing our applications with the S-100 WG community via Basecamp. User feedback is collected and presented in this report at S-100 WG meetings.

4.2 SUMMARY INFORMATION ON TESTBED RESPONDENTS / PARTICIPANTS:

No feedback to report on our viewer release from December 2017 or other documentation submitted.

4.3 PROCEDURE USED IN THE TESTBED:

4.3.1 Technical solutions used

SPAWAR S100Viewer application (running on Microsoft Windows 7 and above) via Basecamp distribution to working group community.

4.3.2 Standards

Application specific information and limitations are available in the release notes of the S100Viewer application.

5 TESTBED RESULTS

5.1 SUMMARY OF FINDINGS:

Implemented an “optimized” Lua-based portrayal to illustrate and support analysis of portrayal performance issues discussed at TSM 5, Arlington, VA. Several optimization techniques and basic caching schemes were used. Further portrayal optimization is possible, but the current implementation provides a meaningful way to compare portrayal performance at different processing stages.

At this time, no rendering optimization has been done as rendering optimizations tend to be vendor specific.

At this time we have not received any feedback on the Lua portrayal implementation. When provided, other working group member’s assessments of the Lua portrayal initiatives will be included in section 4.2 of this report.

5.1.1 Presentation of data

Issues encountered in data processing are indicated in this section.

5.1.1.1 Exchange Sets

It is not currently possible to implement automated data discovery and import. The current exchange set schema should be provided along with test exchange sets / exchange catalogues.

5.1.1.2 GML S-123

1. Consistent use of enumeration types within datasets is recommended. We recommend using the integer code value (vice the label) to be consistent with ISO8211 datasets and portrayal implementation. When a label is encountered where a code is expected our viewer will output a validation notification as follows:

```
_AssignEnumerations() issue.  
RadioServiceArea gml:id= JS.RDOSVC.99 attr.name=categoryOfCommPref.  
Dataset encoded S100FC:label [preferred calling] instead of S100FC:code [1].
```

2. Multiplicity issues exist within the provided dataset. The viewer will validate the multiplicity of attributes provided in a dataset against that defined by the feature catalogue. For example:

```
[JS.RDOSVC.99] attribute [transmissionContent] contains 18 value(s), but must  
contain no more than 1 value(s).
```

3. Feature Catalogue attribute lookup failures have also been encountered. Often, these are due to a failure to validate the dataset against the feature catalogue, and are the result of simple spelling or case errors. For example:

```
Attribute enum failed lookup: [RadioServiceArea], id= [JS.RDOSVC.72], value=  
[NBDP Telegraphy].
```

In this case, the dataset contains *NBDP Telegraphy*, while the feature catalogue contains *NBD Telegraphy (Narrow Band Direct Printing Telegraphy)*.

5.1.1.3 GML S-412

At the request of NOAA/NWS Ocean Prediction Center we took a brief look at an S-412 dataset encoded in the GML format. We identified issues similar to other GML based prototypes and provided feedback to NOAA/NWS.

Additional prototyping is needed as the GML encoding in S-100 Part 10-B has been modified.

5.1.1.4 HDF5

1. Part 10-C does not provide sufficient detail to add support for gridded datasets such as S-111 and S-102. There is no clear mapping from the dataset encoding to S-100 concepts (feature model, spatial model, application schema / feature catalogue), and unlike ISO-8211 the mapping cannot be easily inferred.
2. Reviewed a draft of updates to Part 10-C provided by Portolan Sciences (Raphael Malyankar and Eivind Mong). Provided comments for consideration as Part 10-C development continues.
3. Met with David Brazier and Stacey Johnson regarding S-102. Some issues noted during the meeting were:

- a. Gridded products use null values to represent areas where no data is available. Each product type may use a different value to represent null in their datasets. In theory, each dataset, or each attribute of a dataset, could use a different value to represent null.

We recommend providing a standard mechanism in S-100 so that the value used to represent null within an encoding can be detected by viewers. One way to do this would be to provide standard metadata in Part 10-C describing the value used to represent null for each attribute of a *Coverage*.

- b. The SPAWAR S100Viewer needs to implement the spatial model for *Coverage* as described in Part 8 and ISO 19123. SPAWAR will investigate using the GML schema (.xsd) for *Coverage* if available.
- c. Updates to Part 10-C should be coordinated with S-102 and S-111 working groups so that feature catalogues and datasets align with the changes.
- d. During the meeting we could not verify that the latest S-100 schema files (.xsd files) were being used. A central repository that contains the current (published) and/or latest (developmental) xsd's should be made available.

5.1.1.5 *Lua Portrayal*

1. While implementing the Lua portrayal it was noted that Part 9 does not explicitly describe how drawing instructions with the same display priority should be ordered. It is assumed that drawing instructions should be ordered as specified in S-52 (areas are drawn first, followed by lines, points, and text). This should be explicitly stated in Part 9.
2. Submitted a new S-100 section for product scripting support, notionally called "Part 50". This establishes a structured method for implementing generalized scripting support based on the Lua scripting language.
3. Submitted a companion for S-100 Part 9 detailing Lua Portrayal notionally called "Part 9A". Part 9A defines how portrayal is implemented utilizing the scripting support defined in Part 50.
4. Lua Portrayal (Part 9A-13) requires the addition of "LUA" to Appendix 4a-D "Discovery Metadata for Information Exchange Catalogues", table S100_SupportFileFormat.
5. Status of S-101 Lua portrayal catalogue implementation:

Portrayal of the following feature types is not implemented as symbols are not available; these features are new for S-101 and don't have S-52 equivalents. They currently portray using default symbology (magenta question mark):

- BuoyEmergencyWreckMarking
- CollisionRegulationLimit
- DiscolouredWater
- OffshoreWindTurbine

- PhysicalAisAidToNavigation
- PilotageDistrict
- TextPlacement
- VesselTrafficServiceArea
- VirtualAisAidToNavigation

The following feature types are intentionally not portrayed since they have no spatial (portrayal outputs a *NullInstruction*). They are container types for other features.

- DeepWaterRoute
- IslandGroup
- TrafficSeparationScheme

LocalDirectionOfBuoyage only shows the arrow, not the red and green circles.

Need to verify drawing priority and placement for DEPCNT03 (contour labels).

Currently, we do not intend for the portrayal to generate drawing instructions for symbols associated with automatic or manual chart updates such as CHRVDEL1. The symbols are provided in the portrayal catalogue, it will be the manufacturers responsibility to generate drawing instructions and render them along with the rest of the portrayal.

Issues related to selectors (portrayal context parameters / viewing groups) required by IEC 61174 are noted below:

- Chart boundary
 - Not clear how this is different from Chart scale boundaries selector, perhaps this refers to viewing group 21030 while "Chart scale boundaries" refers to viewing group layer 6?
 - Viewing group 21030 is provided in the portrayal catalogue.
- Chart scale boundaries
 - No drawing instructions to render the chart scale boundaries are output by portrayal. It will be the manufacturers responsibility to generate drawing instructions and render them along with the rest of the portrayal.
 - Viewing group layer 6 is provided in the portrayal catalogue.
- Date dependent
 - Addressed in a separate section of this report.
- Highlight date dependent (turn on/off symbol indicating date dependent objects)
 - Recommend adding a separate viewing group for the date dependent symbol CHDATD01. This would allow the symbol to be turned on and off without having to regenerate the portrayal.
- Supplementary Information / Highlight info (turn on/off symbol for INFORM and NINFOM)
 - Portrayal does not yet generate drawing instructions for INFORM01.
 - Note: selector for viewing group 31030 is identified as "Supplementary Information" in conformance with S-101. IEC 61174 identifies this selector as "Highlight Info". Recommend harmonizing selector naming or noting the discrepancy in S-101.

- Additional Documents / Highlight document (turns on/off symbol for TXTDSC, NTXDS, and PICREP)
 - Portrayal does not yet generate drawing instructions for INFORM01.
 - S-101 C2.8.4.1.3 shows viewing group 31031 as deleted. IEC 61174 requires this selector. The portrayal does not currently provide this viewing group selector.
 - Should viewing group 31031 be provided?
 - Recommend harmonizing naming or noting the discrepancy in S-101.
- National language
 - Context parameter needs to be added
 - Code to evaluate the context parameter needs to be added to the portrayal
- Safe depths shown
 - Recommend providing separate viewing groups for safe soundings vs. unsafe soundings to prevent regeneration of portrayal when selector changes. Both viewing groups should be added to viewing group layer 11 (Spot soundings).

5.1.1.1 *Augmented Drawing Instructions and Chart Rotation*

1. The following XSLT generated drawing instructions do not allow for proper portrayal when the chart is rotated:

- *AugmentedRay*
- *AugmentedPath:ArcByRadius*
- *AugmentedPath:Annulus*

The issue occurs when the feature to be portrayed does not share a common CRS for all elements of an augmented drawing instruction. For instance, when drawing SectorLight leg lines, the portrayal may output:

```
<augmentedRay>
  <featureReference>5155</featureReference>
  <viewingGroup>27070</viewingGroup>
  <displayPlane>OVERRADAR</displayPlane>
  <drawingPriority>24</drawingPriority>
  <crs>LocalCRS</crs>
  <lineStyle>
    <intervalLength>5.4</intervalLength>
    <pen width=".32">
      <color>CHBLK</color>
    </pen>
    <dash>
      <start>0</start>
      <length>3.6</length>
    </dash>
  </lineStyle>
  <direction>53</direction>
  <length>25</length>
</augmentedRay>
```

Note that the CRS must be shared by the direction and length of the ray. However, when the chart is rotated, the length requires *LocalCRS* (assuming FULL_SECTORS is off), but the direction requires

GeographicCRS so that the line rotates with the chart. Using different CRS values for direction and length is not possible with the current schema.

5.1.1.2 *Date Dependent Portrayal*

The following issues were noted while investigating the Lua implementation of S-101 date dependent features. These issues also apply to XSLT portrayals:

1. The type of a portrayal context parameter is specified by 9-13.3.27 *ParameterType*. This is an enumeration where one of the values is "Date", described as "A date according to the Gregorian calendar". The description of the "Date" type should be more clearly defined by adding a reference to an ISO or S-100 date type. For example, see S-100 4a-5.6.4 "Data and Date Time information".
2. IEC 61174:2015 requires a selector for Date dependent objects. This selector should be capable of expressing the following, as specified in IEC 61174:2015 5.3.3:
 - A mariner selected date, such as the current date
 - A date range (start viewing date and end viewing date)

There are many possible ways to encode these values using portrayal context parameters. We recommend providing a portrayal context parameter type capable of expressing a date or date range in a common format which would be used by all product types.

3. The granularity of the "Date" type in Part 9 is one day. This is sufficient for implementing S-101 date dependent objects, but may not be sufficient for other product types. We recommend considering the required granularity of the date type in conjunction with implementing item 2.
4. There is no way to specify the following concepts as default values for context parameters:
 - The current date and/or time
 - The date and/or time of creation or modification (e.g. when a route was created or modified)

Note that as currently defined, date dependent portrayals will require periodic regeneration of the portrayal. This could be avoided if the date / date range were provided in the drawing instruction(s) (similar to line suppression).

6 UNRESOLVED ITEMS FROM PREVIOUS REPORTS

The following items were noted in previous reports and have not been resolved.

1. Modify the S-101 XSLT portrayal catalogue to conform with S-100 Part 9 drawing instruction sorting rules via the addition of a `RADAR_OVERLAY` context parameter and modification of the portrayal rules.

Recommend closing as OBE if no S-101 XSLT portrayal is to be provided.

7 CONCLUSIONS AND RECOMMENDATIONS

7.1 CONCLUSIONS:

The S-101 Lua based portrayal implementation continues to show promise in addressing performance limitations noted with XSLT portrayal implementations.

S-100 support for gridded products, particularly those using HDF5 encodings, needs further refinement. In particular, there are ambiguities with mapping a part 10-C encoding to an application schema / spatial model (see section 5.1.1.3).

7.2 RECOMMENDATIONS:

1. Place the various files needed for S-100 and derived product development (schemas, catalogues, test datasets, etc.) under configuration control so that they are available to manufacturers. Both current and developmental files should be available.
2. Along with recommendation one, provide the updated schema for *S-100_ExchangeSet* along with associated test data.
3. Agree on a consistent way to represent enumeration types (code vs. label) within GML and HDF5 dataset encodings.
4. Update GML dataset(s) to resolve validation errors.
5. Provide updated GML datasets which conform to the latest updates to Part 10-B.
6. Continue development of Part 10-C, working towards providing the detail needed to map an HDF5 encoding to an S-100 application schema.
7. Provide a standard mechanism to describe the value used to encode null attributes within gridded datasets.
8. Update Part 9 so that order of drawing instructions with the same display priority is explicitly stated.
9. Incorporate "Part 50" and "Part 9a" into S-100.
10. Add "LUA" to *S100_SupportFileFormat*.
11. Provide symbols for new S-101 features so that they can be symbolized by portrayal.
12. Ensure S-101 provides guidance on implementing portrayal of chart scale boundaries.
13. Add a viewing group to S-101 for CHDATD01 named "Highlight Date Dependent".
14. Harmonize S-101 and 61174 regarding name of viewing group 31030 (Supplementary Information vs Highlight Info).
15. Verify whether S-101 C2.8.4.1.3 should provide viewing group 31031 (Additional Documents / Highlight document). If so, harmonize name.

16. Add separate viewing groups to S-101 for safe and unsafe soundings, and add both to viewing group layer 11 (Spot soundings). The viewing group for safe soundings is used to meet 61174 selector requirement for "Safe depths shown".
17. Review the S-101 Lua Portrayal Catalogue implementation and provide feedback.
18. Modify Part 9 drawing instruction schemas to allow for correct XSLT generated portrayal of rotated charts.
19. Agree on a required granularity for date dependent features.
20. Provide a portrayal context parameter type capable of expressing either a date or a date range with the required granularity.
21. Provide a mechanism to specify default values as noted in 5.1.1.2.4.
22. Investigate modifying portrayal drawing instructions so that changing the date dependent object selector does not require regenerating the portrayal.

8 PUBLICATIONS

N/A

9 REFERENCE MATERIAL

S-100 Edition 3.0.0 Final

S-101 ENC Product Specification Baseline 0.0.2

SPAWAR S-100 Viewer v1.3.0.0

S-101 XSLT Portrayal Catalogue v0.9.1

S-101 Lua Portrayal Catalogue v0.9.1

S-101 Feature Catalogue v0.8.9 (2015-06-29)

S-122 Feature Catalogue (S122FC_20170504.xml), version 1.0.0-20170504 (MODIFIED)

S-122 Sample Data (USNPI122EX_00001.gml) (MODIFIED)

S-122 Portrayal Catalogue (Custom, derived from S-101 XSLT Portrayal Catalogue)

S-123 Feature Catalogue v1.0.0-20170430 (S123FC_20170430.xml)

S-412 Feature Catalogue v0.1 and datasets circa October 2017