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
- **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:** February 5, 2019

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 based 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:

4.2.1 S-100 Part 13 Clarification

Provided clarification to testbed participants that the scripting functions defined in S-100 Part 13 are language independent – they are to be coded to execute in the hosts Lua sandbox, which can be implemented in the programming language of choice (C, C++, C#, Java, etc.)

We have begun work on a C++ reference implementation of an S-100 Lua portrayal engine. The reference implementation will emit drawing instructions as text strings (it will not render the drawing instructions). Once complete the source code will be made available on Basecamp.

RECOMMENDATION 1: Endorse development of a reference implementation

4.2.2 S-100 Part 10a Data Structure Codes

It was discovered that the data structure codes listed in S-100 Part 10a for *C2IT* and *C3IT* are incorrect. A change proposal has been prepared to correct the issue.

4.2.3 Viewer Bug

It was discovered that the SPAWAR Viewer v1.5 expects all attributes described in the feature catalogue to be present in S-100 Part 10a encoded *ATCS* fields. The bug has been corrected in v1.6.

4.2.4 S-100 Part 13 Encode/DecodeDEFString

It was discovered that the S-101 portrayal catalogue delivered with SPAWAR Viewer v1.5 does not implement the Lua Encode/DecodeDEFString functions. These functions are included in the SPAWAR S-101 Portrayal Catalogue delivered with SPAWAR Viewer v1.6.

4.2.5 SAFCON5X symbols

KHOA provided updated SAFCON5X symbols which have been incorporated into the SPAWAR S-101 Portrayal Catalog.

4.3 PROCEDURE USED IN THE TESTBED:

4.3.1 Technical solutions used

SPAWAR S100Viewer application (running on Microsoft Windows 7/10) 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:

Changes in SPAWAR S100Viewer version 1.6.0.0:

- Available on Basecamp.
- Supports S-100 4.0 feature catalogue schema (S100FC.xsd) changes. Feature catalogs which do not conform to the latest schema are no longer supported.
    - S100_FC_SpatialPrimitiveType - removed *arcByCenterPoint*, *circleByCenterPoint*.
    - S100CI:Citation -> S100CI:CI_Citation_Type (name and schema changed)
    - S100CI:ResponsibleParty -> S100CI:CI_Responsiblity_Type (name and schema changed)
- Uses SPAWAR S-101 Portrayal Catalog 1.0
    - Requires S-101 Feature Catalogue 1.0 and accompanying S-101 dataset converter.
        - Some feature types switched from using the complex attribute type *orientation* to using the simple attribute type *orientationValue*. The rules have been updated to reflect this change.
    - Previous feature catalogues and converted datasets are no longer supported.
    - Contents validated against S-100 portrayal schemas available on GitHub.
    - Provides all viewing groups not specified as a range (see 5.1.1.1.3), including mariners and manufacturers.
    - Abbreviations implemented per S-52 PresLib Part 1 14.6.
    - Includes updated SAFCON5X symbols.
    - Implemented results of Portrayal Catalogue Builder project:
        - Includes testPCB symbol "  ", updated to comply with the S-100 SVG profile. Updated symbol provided to KHOA for inclusion in the symbol registry.

        - Updated portrayal catalogue to use testPCB symbol for features as identified in S-101 PCB_New_Features.xlsx.
    - Features with associated *NauticalInformation* now get an INFORM01 symbol using ViewingGroup 31030 (no external file) or 31031 (external file), however note item 5.1.1.1.2.
- Portrayal / Rendering changes:
    - Uses a new rendering engine in anticipation of Shore ECDIS requirements for multiple datasets / interoperability support.
    - Symbols:
        - Uses CURSRA01 / CURSRB01 (if available) to create cursor.
        - Colors change with the selected palette.
            - Assumes approval of proposal: Palette Support for Symbols.
        - Placement in accordance with S-52 PresLib 8.5.1 – *Positioning centred symbols and text*.
        - Support SVG *stroke-miterlimit*, *stroke-linecap*, and *stroke-linejoin*.
        - Text is only displayed if "base" object is displayed, however see 5.1.1.1.6.
    - Added support for masked spatials as described in S-100 9-7.5.
    - Added support for line suppression as described in S-100 9-11.1.8 and 9a-11.2.1.
- User Interface changes:
    - S-100 Browser tab now shows the *NauticalInformation* text, including information from external files. External picture files are not yet supported.
- Dataset / Encoding changes:
    - Validates *InformationAssociations* / *FeatureAssociations* during loading.
    - Warns on orphan (unreferenced) *InformationObjects.*
    - Correctly handles unknown mandatory attribute values.
    - Only attributes used within the encoded dataset are required to be present in the *ATCS* fields.

The 1.6.0.0 testbed was used to:

- Continue assessing Lua scripting (S-100 Part 13) and portrayal (S-100 Part 9a).
- Support review of version 1.0.0 of the S-101 feature catalogue and dataset converter.
- Prototype loading and portrayal of HDF5 encoded datasets

5.1.1 Presentation of data

Issues encountered in data processing are indicated in this section.

5.1.1.1 S-100

Issues not specific to a particular product type are presented in this section.

5.1.1.1.1 *DisplayPlanes* container name

The S-100 9-A-5 portrayal catalogue schema (and XSD on GitHub) does not agree with the S-100 UML in Figure 9-20 and table 9-13.3.1 with regard to the container name for *DisplayPlanes*. The UML correctly shows “displayPlanes”, while the XSD uses “displayPlane”.

RECOMMENDATION 2: Address at TSM7 along with any other proposed portrayal schema changes

5.1.1.1.2 Symbol INFORM01

Per S-52 PresLib Part 1 10.6.1.1 “SY(INFORM01) is intended as a temporary overlay”. S-100 Part 9 has no provision for temporary overlays other than turning on and off the viewing group.

RECOMMENDATION 3: Provide feedback on implementation of “temporary” overlays, address at TSM7

5.1.1.1.3 Viewing Group Range

When adding viewing groups to the S-101 Portrayal Catalogue it was noted that e.g. manufacturers’ features are specified as a range of possible values (45000-45999) whereas the PC schema only supports single values. This would require adding hundreds of individual entries to support all values in the range.

RECOMMENDATION 4: Address at TSM7 along with any other proposed portrayal schema changes

5.1.1.1.4 Lua portrayal missing clipSymbols on SymbolFill

The UML in S-100 Figure 9-17 shows a *clipSymbols* attribute on class SymbolFill. Table 9-12.5.1.6 does not list the attribute. The attribute is included in the 9-A-2 Symbol Definition Schema. Part 9 does not

describe the intended function of *clipSymbols*. The attribute is not included in the S-100 Part 9a *SymbolFill* drawing instruction.

RECOMMENDATION 5: Provide feedback on intent of *clipSymbols*, determine course of action

5.1.1.1.5 Part 9a does not support endOffset

The Part 9a *TextInstruction* uses the *LinePlacement* command to specify where on a line text is anchored. The XSLT *TextLine* instruction provides an optional second offset (*endOffset*) which is not available via *LinePlacement*.

RECOMMENDATION 6: SPAWAR to prepare change forms for discussion at TSM7

5.1.1.1.6 Symbol / Viewing Group Dependencies

The portrayal catalogue can generate multiple drawing instructions for a single feature, and each of these drawing instructions may have a unique viewing group. In some cases, the drawing instructions for a given viewing group should only be executed if some other viewing group is enabled. Examples include portrayal of labels and INFORM01. A mechanism to express the required dependencies should be developed.

RECOMMENDATION 7: SPAWAR to prepare a paper for TSM7

5.1.1.1.7 Positioning centred symbols and text

S-52 PresLib 8.5.1 provides specific direction on the placement of centred symbols and text. Should these be incorporated into S-100 Part 9 and applied to all product types? Otherwise each product type will need to indicate how centred symbols and text should be placed.

RECOMMENDATION 8: Provide feedback. If necessary SPAWAR to prepare change forms for discussion at TSM7

5.1.1.2 S-101 Portrayal

5.1.1.2.1 Cannot Draw Light Sector Arc in Accordance With DCEG

The "Remarks" section of S-101 DCEG Section 30.4 Sector Extension states *"The displayed sector must not exceed the nominal range of the light sector on the ECDIS display."* This restriction can't be implemented in the portrayal because there is no way to correlate the radius of the arc, which is given using *LocalCRS* (in mm), to the on-screen geographic radius (in NM). Additionally, S-52 does not have this requirement.

RECOMMENDATION 9: Resolve with S-101PT

5.1.1.3 S-102 Support

Additional harmonization is required to align the S-102 product specification with the guidance in S-100 4.0 Part 10c. Currently, product-specific code is needed to load S-102 datasets. Custom processing is also required to establish feature and attribute relationships using the existing S-102 feature catalogue.

The S-111 implementation is better aligned with S-100 Part 10c requirements, and can be used as a model for further refinement of S-102. We will continue to work with NAVOCEANO to resolve issues based on testbed results.

5.1.1.3.1 S-102 Bounding Box definition

S-100 Edition 4.0.0, Table 10c-6, defines root group metadata for “Bounding Box”. S-102 should modify the root group attributes to match the current definitions in Part 10c wherever possible instead of encoding as “boundingBox.eastBoundLongitude”. S-102 also defines additional files at the root level: “boundingBox” and “sequenceRule”.

RECOMMENDATION 10: Resolve with S-102PT

5.1.1.3.2 HDF5 File Family

S-102 datasets may include "HDF File Families". There is a very brief reference to this concept in S-100 v4 10c-5, paragraph “Stored Data”.

Standard techniques for opening HDF5 files will fail if the dataset uses “file families”. Currently, the use of "file families" can’t be discovered prior to opening a dataset. In order to process datasets that use file families the following technique must be implemented by manufacturers:

1. create a file access property list
2. modify it to use the file family feature.
3. pass the modified property list to *H5Fopen*.
4. close the property list.
5. continue working in HDF5.

RECOMMENDATION 11: Address at TSM7, possibly by adding a flag to the exchange set metadata

5.1.1.4 S-111 Support

Generally, the S-111 product spec is in good alignment with S-100 Part 10c. We have made changes to the portrayal catalogue in order to support visualization, these changes have been passed back to the S-111 product team. The current portrayal catalogue converts grid values into “points” with “attributes”. In order to visualize this, we created artificial feature unique identifiers at each grid cell point and created an S-100 “feature”.

This approach may have performance implications when using XSLT portrayal rules, since the entire grid must be passed in to the XSLT processor as part of the input schema. We are currently working with the S-111PT to produce a portrayal implementation based on the *Coverage* instruction.

5.1.1.4.1 S-111 Portrayal Catalog

The S-111 portrayal catalogue fails validation against the S-100 portrayal schemas.

RECOMMENDATION 12: Instruct product teams to validate all deliverables against GitHub schemas prior to release.

5.1.1.4.2 S-111 Time Group (Time Series) Visualization

S-111 desires to use time groups (time series) portrayal of data. It is not clear how to properly associate the time series data with the portrayal catalogue.

RECOMMENDATION 13: Address at TSM7, reviewing S-100 Part 9 Portrayal to ensure time series data is able to be represented appropriately without product specific visualization rules. May dovetail with implementation of Date Dependent portrayal.

6 UNRESOLVED ITEMS FROM PREVIOUS REPORTS

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

6.1 ALERTS AND INDICATIONS

A proposed model for alerts and indications was presented at TSM6 (TSM6-4.4).

RECOMMENDATION 14: SPAWAR to prepare an updated model for TSM7 based on feedback received

6.2 PALETTE SUPPORT FOR SYMBOLS

Change forms have been prepared for the WG based on discussions at and following TSM6

6.3 COLOR PROFILE DOES NOT ALLOW FOR SPECIFICATION OF TRANSPARENCY

Products such as S-102 and S-111 use transparency values which vary with the selected color palette. For instance, S-102 DEPDW may have zero transparency (opaque) in the day palette, but 60% transparency in the dusk palette.

This poses a problem when creating the portrayal catalog. Drawing instructions can provide transparency, but since the selected palette is not available to the PC, the transparency provided in the drawing instruction(s) will have the same value for all color palettes.

Change forms have been prepared for the WG

6.4 DATE DEPENDENT PORTRAYAL

As detailed in S-100WG3-8.5 5.1.1.2 there are many issues which need to be resolved in order to implement date dependent portrayal.

RECOMMENDATION 15: SPAWAR to work with interested parties to prepare a proposal for TSM7

6.5 MANUFACTURER RESPONSIBILITIES

The following sections detail portrayal requirements that will need to be implemented by the ECDIS manufacturers. Consideration should be given to adding a section to the portrayal catalog providing the

necessary drawing instructions to implement these manufacturer responsibilities in a machine-readable file.

RECOMMENDATION 16: Extend Part 9 portrayal catalog to allow consistent machine-readable implementation of manufacturer responsibilities, in a manner similar to the interoperability catalogue.

6.5.1 Portrayal of Masked Edges

Masked edges are edges which should not be rendered. Encoded datasets support masking, as does the S-100 Part 9 portrayal input schema, as described in 9-7.5. However, S-100 Part 7 (Spatial Schema) lacks the capability to represent masked edges.

Currently, if a manufacturer loads an encoded dataset into an implementation of S-100 Part 7 the masking information can be lost, unless tracked by the manufacturer outside of the GFM.

Part 9a calls out portrayal of masked spatial elements as a host [manufacturer] responsibility.

RECOMMENDATION 17: Update S-100 Part 9 to indicate manufacturer responsibility for XSLT portrayal.

6.5.2 S-101 Specific Manufacturer Responsibilities

RECOMMENDATION 18: Develop a standard method for products to indicate manufacturer responsibilities

6.5.2.1 Symbolization of Chart Updates

The portrayal does not generate drawing instructions for symbols associated with automatic or manual chart updates such as CHRVDEL1. The symbols are available in the portrayal catalogue but it is the manufacturer's responsibility to generate drawing instructions and render them as part of the portrayal.

6.5.2.2 Symbolization of Chart Scale Boundaries

Symbolization of the chart scale boundaries requires knowledge of the datasets which are visible, adjacent, and have the same maximum display scale. Portrayal does not have this knowledge.

6.5.2.3 Symbolization of Overscale Data Pattern

Symbolization of this pattern requires knowledge of the display scale, and whether the mariner has intentionally over scaled the display. Portrayal does not have this knowledge.

6.5.2.4 Symbolization of Non-HO (Non-ENC) Chart Information

Augmenting HO ENC data with Non-HO data requires superimposing SY(CHCRIDnn) / LC(CHCRIDnn). Since the portrayal has no knowledge of non-HO data it cannot portray the superimposed symbology.

If non-HO data is shown on a separate area of the display its boundary must be identified by linestyle LC(NONHODAT); display priority 3, over radar; display base; viewing group 11060, stroke to the non-HO data side of the line.

6.5.2.5 Symbolization of No Data Areas

The screen must be filled with the grey NODTA colour fill together with the fill pattern AP(NODATA03) prior to drawing any other information. This could be done by portrayal at the start of the drawing instructions, however that could obscure other non-S-101 datasets.

6.6 COVERAGE INSTRUCTION DOES NOT SPECIFY INTERPOLATION METHOD

The *LookupEntry* class (9-12.7.4.2) may reference a *CoverageColor* class (9-12.7.4.3) in order to map an attribute value to a single colour or an interpolated value. For interpolated values, the implied interpolation method is linear.

The interpolation method should be explicitly stated, or an interpolation method should be added to the *LookupEntry* class which takes a value from *CV_InterpolationMethod* consistent with the coverage type of the data.

RECOMMENDATION 19: SPAWAR to prepare change forms for discussion at TSM7

6.7 COVERAGE INSTRUCTION DOES NOT SPECIFY COLOUR SPACE TO USE FOR INTERPOLATION

The *LookupEntry* class (9-12.7.4.2) may reference a *CoverageColor* class (9-12.7.4.3) in order to map an attribute value to a single colour or an interpolated value. In the case of an interpolated value, the colour space used for interpolation is not specified. Linear interpolation within the sRGB colour space may result in undesirable luminosities.

The colour space to use for interpolation should be explicitly stated *(CIE recommended)*, or the colour space to use for interpolation should be added to the *LookupEntry* class.

RECOMMENDATION 20: SPAWAR to prepare change forms for discussion at TSM7

7 PRECONDITIONS OF IEC FOR SOLAS CLASS VESSELS

7.1 ANALYSIS TABLE

Template for OEMs to report on maturation of individual S-100 products. Updated forms should be provided to the WG for inclusion in the testbed report.

Requirement	**Product Meets Req**	**Note**
1.0 Expected functionality		
1.1 Is the functionality limited for “just display” ?		
1.2 Even “just display” requires selectors controlling what is displayed or how items are displayed		

1.3 Warnings and indications with time limits associated with the up-to-datedness of the data		
1.4 If required, alerts or indications based on the content of the product		
1.5 If required, requirements for pick reports		
1.6 If required, rules for interoperability (to be displayed together, how to display together, etc.)		
2.0 Details of service		
2.1 File name and folder conventions		
2.2 Up-to-dateness information		
2.3 Authentication method, including method of pre-sharing of related key(s)		
2.4 If used, method of encryption and method of managing of decryption keys		
3.0 Format of the S-10x product		
3.1 Machine readable feature catalogue		
3.2 Machine readable portrayal catalogue		
3.2 Machine readable schema		
3.3 If required, machine readable alerts and indications catalogue		
3.4 If required, machine readable interoperation catalogue		

8 CONCLUSIONS AND RECOMMENDATIONS

8.1 CONCLUSIONS:

Steady progress continues to be made. We feel that the Issues presented should not preclude meeting the timelines for S-100 v5 and S-101 v2.

8.2 RECOMMENDATIONS:

Provided in-line in preceding sections.

9 PUBLICATIONS

N/A

10 REFERENCE MATERIAL

SPAWAR S-100 Viewer v1.6.0.0

S-100 Edition 4.0.0 Final

S-101 ENC Product Specification Baseline 1.0.0

SPAWAR S-101 Portrayal Catalogue

S-101 Feature Catalogue v1.0.0