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:** August 27, 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:

4.2.1 Svein **S. Skjæveland** of ECC (www.ecc.no)

Attempted to use viewer to load and validate test datasets created by ECC. Loading failed for all datasets. The following issues were identified:

4.2.1.1 *S-100 Part 10a: incorrect data structure codes for C2IT and C3IT*

The data structure codes listed in S-100 Part 10a for *C2IT* and *C3IT* are incorrect. The first character for both fields should be "1".

RECOMMENDATION 1: Correct S-100 Part 10a *C2IT* and *C3IT* data structure codes.

4.2.1.2 *S100 Part 10a: Incorrect RIAS data descriptive field*

RIAS data descriptive field as listed in S-100 Part 10a needs an asterisk directly in front of "RRNM".

RECOMMENDATION 2: None. Change is already incorporated in S-100 4.0.0

4.2.1.3 *S-100 Viewer implementation of ATCS field.*

S-100 viewer 1.5.0.0 expects all attributes from the feature catalogue to be present in the *ATCS* fields whether they are used in the dataset or not.

RECOMMENDATION 3: Implement change to treatment of *ATCS* fields in S-100 viewer 1.6.0.0.

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:

Version 1.5.0.0 of the testbed was made available June 4, 2018 and can be downloaded from the S-100 basecamp site. Contact the S-100 chair for basecamp access.

Changes in version 1.5.0.0:

- Implemented S-52 equivalent portrayal (with caveats as noted in section 5.1.2.1).

- Portrayal uses new scripting model as described in Parts 13 and 9a.

- Text (viewing groups 11 through 30) is now only displayed if its associated feature is also displayed.

    RECOMMENDATION 4: Add requirement to S-100 Part 9.

- Added context parameter *IGNORE_SCAMIN*. If this parameter is set, portrayal will not emit any *ScaleMinimum* instructions. This effectively causes all features to be drawn at all display scales. Note that this could be implemented more efficiently by having the manufacturer ignore *ScaleMinimum* instructions in the drawing commands emitted by the portrayal.

- Added portrayal context parameter *NATIONAL_LANGUAGE* and removed viewing group 31 (National Language Text). This context parameter allows the mariner to select his language of preference for chart text. The portrayal will emit text in the specified language if it is available, otherwise the default language will be emitted.

- Drawing priority is now properly ordered by priority then by drawing type (area, line, point, text).

- Modified performance logging to support Lua portrayal evaluation.

- Updated simulated RADAR sweep to use portrayal color palette.

The 1.5.0.0 testbed was used to:

- Implement and provide empirical evidence supporting the S-100 scripting support detailed in S-100 Part 13.

- Implement S-101 portrayal via S-100 Part 9a (Lua Portrayal). The updated portrayal is intended to facilitate stakeholder analysis of S-101 Lua based portrayal.

Changes in upcoming version 1.6.0.0:

- Incorporates changes as described throughout this report, including issues noted in 4.2.1.

- 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)
- Will be delivered with S-101 Portrayal Catalog 1.0
  - Supports S-101 Feature Catalogue 1.0 and accompanying S-101 dataset converter.
  - Previous feature catalogues and converted datasets are no longer supported.
  - Rules for LocalDirectionOfBuoyage updated to use marksNavigationalSystemOf attribute. Version 1.0 of feature catalogue required.
  - Updated symbols to support colour palettes as described in 5.1.2.1.1.
  - Implemented S-52 equivalent portrayal of qualityOfBathymetricData (viewing group 31010 - Accuracy of data, survey reliability, quality of data).
- Updated to support portrayal catalog symbols containing alternate stylesheets as described in 5.1.2.1.1.
- Uses a new rendering engine in anticipation of Shore ECDIS requirements for multiple datasets along with interoperability support.
- Will be available on Basecamp once S-101 Feature Catalogue and accompanying dataset converter are finalized and converted datasets can be tested with the updated portrayal.

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.

Feedback received on Lua portrayal will be added in section 4.2 of this report.

5.1.1 Alerts and Indications

Details on a proposed alerts and indications model are presented in a separate paper.

5.1.2 Presentation of data

Issues encountered in data processing are indicated in this section.

5.1.2.1 S-100 Portrayal

Portrayal issues not specific to a particular product type.

5.1.2.1.1 Palette Support for Symbols

Implementing the mechanism described in S-100 to change the color palette of SVG symbols poses several challenges:

- The stylesheet files used to change the symbol colors are not catalogued within the portrayal catalogue.

- The stylesheets are in the "ColorProfiles" folder, but must be referenced from the "Symbols" folder. This is related to the cataloging issue.

- The stylesheets have no relationship to the palettes defined by a ColorProfile; applications can't algorithmically determine which stylesheet to use when the palette is changed.

- Applications, particularly web-based portrayal such as the IHO registry website, may not be able to support changing the stylesheet file dynamically.

In order to overcome these issues in a standards compliant manner we have previously proposed the use of alternate stylesheet directives within the symbol files. During the reporting period we have investigated refinements to the previous proposal with the goal of adding palette support to S-101 symbols used by the S-100 testbed viewer.

The previous proposal addressing this issue was presented as S-100WG2-8.9, items 6-7. The changes to that proposal are as follows:

1. The title attribute of the stylesheet reference should match the id of a ColorPalette. This removes the need for a paletteName attribute when cataloging the stylesheets.

   a. <?xml-stylesheet href="nightSvgStyle.css" alternate="yes" ***title="Night"*** type="text/css"?>

2. If the stylesheets are placed in the "Symbols" folder it is not required to catalog them because they are implicitly cataloged by reference from the SVG files. It may still be desirable to catalog the stylesheets within the portrayal catalog in order to support encryption, digital signature, etc.

3. It has been noted that alternate stylesheets are not supported by all browsers. In particular, Chrome does not support them unless an extension is used. This can be overcome via javascript added to the webpage which displays the SVG symbols, as shown in Figure 1. A sample implementation of the javascript will be provided along with this report.

Figure 1 - Browser display of SVG symbol with dynamic palette support

4. In order to support the presentation shown above we recommend that the following html styling information be added to each stylesheet: **.svgSymbolClass { background-color #93AEBB; }** where the hex color code matches the "NODTA" color defined within the stylesheet.

5. The portrayal catalogue builder should be updated to support these recommendations. These changes may be minimal if the builder does not create the SVG symbols; in this case only minor changes to the catalog packaging would be necessary.

RECOMMENDATION 5: Update symbols to use primary and alternate stylesheets. Each stylesheet reference should have a "title" attribute matching a portrayal ColorPalette id.

RECOMMENDATION 6: Deliver stylesheets in the "Symbols" folder.

RECOMMENDATION 7: Determine whether the stylesheets should be cataloged.

RECOMMENDATION 8: Update registry website to dynamically support primary and alternate stylesheets.

RECOMMENDATION 9: Add a class (.svgSymbolClass) supporting HTML styling to each stylesheet.

RECOMMENDATION 10: Update portrayal catalogue builder if necessary.

RECOMMENDATION 11: Update S-100 Part 9 to reflect these changes.

5.1.2.2 S-101 Portrayal

As part of the 1.5.0.0 release of the testbed viewer, and supporting the initial release of S-101, a Lua based portrayal was provided. This section details known issues, work remaining, and changes from S-52. Section 0 of this report should also be consulted for previously reported but unresolved issues.

5.1.2.2.1 Portrayal of *QualityOfBathymetricData*

The S-101 feature type *QualityOfBathemetricData* is the replacement for the S-57 *CATZOC* attribute of the *M_QUAL* object type. As noted in:

- TSM3-3.5: https://www.iho.int/mtg_docs/com_wg/S-100WG/TSG3/TSG3_docs.htm

- https://www.iho.int/mtg_docs/com_wg/DQWG/DQWG9/DQWG%20-
%20New%20ways%20of%20representing%20quality%20of%20bathymetric%20data%20for%20su
rface%20navigation.pdf

the S-101 portrayal of *QualityOfBathemetricData* has not been finalized.

S-100 Viewer 1.5.0.0 does not portray *QualityOfBathemetricData*. S-100 Viewer 1.6.0.0 will use the attributes of *QualityOfBathemetricData* to perform a lookup in the ZOC table (ref. S-57 Appendix A Chapter 2 page 2.107). The result of this lookup allows the S-100 Viewer to perform an S-52 equivalent portrayal.

RECOMMENDATION 12: Provide guidance on portrayal of *QualityOfBathymetricData*.

5.1.2.3 S-102 Portrayal

5.1.2.3.1 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.

RECOMMENDATION 13: Add interpolation method to *LookupEntry* class. One of *CV_InterpolationMethod* consistent with the coverage type of the data shall be used.

5.1.2.3.2 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. Note that linear interpolation within the sRGB colour space may result in undesirable luminosities.

RECOMMENDATION 14: Add a colour space interpolation to the *LookupEntry* class or alternatively specify the CIE colour space as the default interpolation colour space.

5.1.2.3.3 Color Profile Does Not Allow for Specification of Transparency

When defining the colour value for a colour token, the colour profile does not allow for the specification of a transparency (alpha) value. In other words, the color profile should specify ARGB (sRGB with alpha) rather than RGB (sRGB), or AxyL (CIE with alpha) rather than xyL (CIE).

BACKGROUND: S-102 portrayal (issue applies to S-111 as well, Version 1.0.0, Date August 2018, Section 9.2.6, Table 9.5) uses different transparency values (Alpha values in version 2.0.0, Section 9.2.3, Table 9.2) depending on which colour palette (day/night/dusk) is currently selected. For instance, water deeper than the deep contour displays the colour token DEPDW with zero transparency for the day palette. Whereas the deep contour displays the same colour token with 60% transparency for the dusk palette.

Portrayal cannot use the colour override capability in this case because the selected colour palette is not available to the portrayal.

Any additive effects of applying transparency to a colour profile entry shall be accomplished by multiplying the alpha channel values together. This allows the default transparency value of zero (i.e. alpha of 1.0) to not affect the original specified transparency. For instance, when drawing a 25% transparent feature the final transparency value would be 1 / 25% * the alpha of the colour token.

RECOMMENDATION 15: Add ability to specify an alpha channel in the colour profile.

5.1.3   Portrayal Catalogue Builder Lua Support

SPAWAR has developed a tool to convert S-52 DAI files to S-100 Part 9a compliant Lua rules. This tool was used to generate the majority of the S-101 portrayal catalogue provided with the SPAWAR viewer application. The source code for this tool was provided to KHOA on 22 August 2018.

The code should assist KHOA in modifying the Portrayal Catalogue Builder to support generation of S-100 Part 9a Lua compliant portrayal catalogues.

5.1.4   S-102 Support

- Provided review and feedback of the S-102 Product Specification.

- Had discussions with David Brazier and Stacy Johnson on the status of the test dataset, feature catalog, and portrayal catalog.

- Working with the test dataset to verify format and general specification functionality.

- Testing the Linux based BAG to S-102 format converter utility and porting it to a windows environment.

5.1.5   S-111 Support

- Supported review and feedback of the S-111 Product Specification.

- Had dialog with Kurt Hess, awaiting test versions of a feature and portrayal catalog.

- Currently prototyping S-111 support within the S100Viewer.

- Updated the S-111 Dataset Generator and Validation tools to work with the latest version of the product specification.

5.2 PRECONDITIONS OF IEC FOR SOLAS CLASS VESSELS

Referencing S-100WG3-9.3.3, "Preconditions of IEC to consider inclusion of S-100 into the ECDIS standard", a new section 6 was proposed to the S-100WG chair with the existing sections to be renumbered starting at 7. The new section 6 would be titled: "S-100 Product Maturation / SOLAS Applicability Analysis" with sub-sections for each S-100 based product to include an analysis table. Test data and expected results would continue to be captured in section 5 of the testbed report.

5.2.1 Analysis table

Each OEM can report on maturation of individual S-100 products by providing an updated version of the table below 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-dateness 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		

RECOMMENDATION 16: Provide direction on inclusion of section 6 "S-100 Product Maturation / SOLAS Applicability Analysis".

6 UNRESOLVED ITEMS FROM PREVIOUS REPORTS

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

6.1 PALETTE SUPPORT FOR SYMBOLS

See 5.1.2.1.1 for description and recommendations. Version 1.6.0.0 of the S-100 Viewer application will support the proposed recommendations.

6.2 SYMBOLIZATION OF DATE DEPENDENT FEATURES / HIGHLIGHT DATE DEPENDENT

As detailed at S-100WG3-8.5 there are many issues which need to be addressed within S-100 prior to implementing date dependent portrayal. Once these issues are resolved the S-101 portrayal should be updated to support date dependent features / highlight date dependent.

RECOMMENDATION 17: Address portrayal of date dependent features in S-100 v5 / S-101 v2.

6.3 MASKED EDGES

S-100 Part 7 (Spatial Schema) lacks the capability to represent masked edges. The concept of masked edges is described in Part 9-7.5 which defines a masked relation that extends the SpatialRelation type (which is essentially the same as the spatial attributes in the GFM). CurveRelation derives from this type which allows the possibility of selectively masking edges on a curve or surface feature as well as applying masking to entire geometries.

Encoded datasets also support masking. Currently, if a manufacturer loads an encoded dataset into an implementation of S-100 Part 7 the masking information is lost.

RECOMMENDATION 18: Extend GM_OrientablePrimitive in Part 7 (Spatial Schema) to include a masking field or specify the manufacturer is responsible for keeping track of masked edges when loading an encoded dataset.

6.4 HIGHLIGHT INFO / HIGHLIGHT DOCUMENT

This information was encoded in *SupplementaryInformation*, but as of FC 0.9.3 is encoded in *NauticalInformation*. The S-101 dataset converter does not support either encoding. The portrayal needs to be updated to examine *NauticalInformation* and output appropriate symbology using viewing group 31030 (Highlight Info) and viewing group 31031 (Additional Documents).

In order to minimize the need to regenerate the portrayal there are no context parameters provided for Highlight Info / Highlight Document. The display of the highlight symbols can be controlled via the viewing groups. We recommend adding a new viewing group layer to support toggling these symbols on / off as a group.

RECOMMENDATION 19: Update portrayal for S-101 v2 to support Highlight Info / Highlight Document.

RECOMMENDATION 20: Add viewing group layer to turn on / off viewing groups used for highlight symbols.

6.5   ISSUE: MISSING SYMBOLS

As detailed at S-100WG3, portrayal of the following feature types is not implemented as symbols are not available; these features are new – they have no S-52 equivalent. The current portrayal catalogue will symbolize these features using default symbology (magenta question mark):

- BuoyEmergencyWreckMarking
- CoastguardStation (surface feature)
- CollisionRegulationsLimit
- CurrentNonGravitational (curve and surface feature)
- DiscolouredWater
- FloatingDock (point feature)
- InformationArea (curve feature)
- LandRegion (curve feature)
- OffshoreWindTurbine
- PhysicalAisAidToNavigation
- Pile (curve feature)
- PilotageDistrict
- Pontoon (point feature)
- SignalStationTraffic (surface feature)
- SignalStationWarning (surface feature)
- TextPlacement
- VesselTrafficServiceArea
- VirtualAisAidToNavigation
- WindTurbine

RECOMMENDATION 21: Develop and provide missing symbols with S-101 v2.

6.6   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 22: Extend Part 9 portrayal catalog to allow consistent machine-readable implementation of manufacturer responsibilities, in a manner similar to the interoperability catalogue.

6.6.1 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.

RECOMMENDATION 23: Update S-101 v2 to indicate manufacturer responsibility.

6.6.2 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.

RECOMMENDATION 24: Update S-101 v2 to indicate manufacturer responsibility.

6.6.3 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.

RECOMMENDATION 25: Update S-101 v2 to indicate manufacturer responsibility.

6.6.4 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.

RECOMMENDATION 26: Update S-101 v2 to indicate manufacturer responsibility.

6.6.5 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.

RECOMMENDATION 27: Update S-101 v2 to indicate manufacturer responsibility.

6.6.6 Portrayal of Masked Edges

Masked edges are used to indicate to portrayal that the edge shall not be drawn during portrayal. Placing the responsibility on the portrayal rules to process the masked edges requires that the portrayal examine all edges of all curve and area features to determine if masked edges exist. Since the vast majority of features do not contain masked edges this places a significant processing burden on the portrayal rules.

Part 9A specifies that the processing of masked edges is a manufacturer's responsibility.

RECOMMENDATION 28: Update S-100 Part 9 to indicate manufacturer responsibility for XSLT portrayal.

7 CONCLUSIONS AND RECOMMENDATIONS

7.1 CONCLUSIONS:

The imminent publication of S-100 v4.0.0 reflects the strong progress that has been made since the previous TSM. We feel that there are no recommendations presented herein that cannot be addressed in the time frame allotted for development of S-100 v5.0.0.

7.2 RECOMMENDATIONS:

Provided in-line in preceding sections.

8 PUBLICATIONS

N/A

9 REFERENCE MATERIAL

SPAWAR S-100 Viewer v1.5.0.0

S-100 Edition 3.0.0 Final

S-100 Edition 4.0.0 Proposed

S-101 ENC Product Specification Baseline 1.0.0

S-101 Lua Portrayal Catalogue

S-101 Feature Catalogue v0.8.10

S-101 Feature Catalogue v0.9.3

S-101 Feature Catalogue v1.0.0