**Paper for Consideration by S-100 WG**

**The Status of S-100 Part 8 (Imagery and Gridded Data)**

| | |
|---|---|
| *Submitted by:* | Raphael Malyankar (on behalf of S-100 WG Chair) |
| *Executive Summary:* | Discussion of the status of S-100's treatment of imagery and gridded information in the light of experience with S-1xx Product Specifications dealing with gridded data. |
| *Related Documents:* | -- |
| *Related Projects:* | -- |

## Introduction / Background

S-100 Part 8 (Imagery and Gridded Data) describes the S-100 conceptual model for imagery and gridded data, based on ISO 19123 and ISO 19129. Part 8 describes the organization, type of grids, and associated metadata and spatial referencing. The data format for gridded data is based on the HDF5 format and is described in Part 10c. In the course of development of Product Specifications and sample data for coverage information, specifically S-111, S-104, and S-102, gaps and deficiencies in Part 8 have been discovered. This paper summarizes them and proposes a review of the treatment of imagery and gridded data in S-100.

## References

[ISO 19123] Geographic information — Schema for coverage geometry and functions. ISO 19123:2005. Reaffirmed 2016.
[ISO 19129] Geographic information — Imagery, Gridded and Coverage Data Framework. ISO/TS 19129:2009. Confirmed 2019.
[S-100] Universal Hydrographic Data Model, Edition 4.0.0, IHO. (December 2018).
[S-102] Bathymetric Surface Product Specification, Edition 2.0.0.
[S-104] Water Levels. Under development.
[S-111] Surface Current Product Specification, Edition 1.0.0. December 2018.
[TSM7 5.10b] Miscellaneous Revisions. (NIWC Atlantic.)

## Gaps in S-100 edition 4.0.0 Part 8

There are various deficiencies in Part 8:

- There are discrepancies or ambiguities between the text and the kinds of coverage data supported by the accompanying conceptual model as depicted by the UML diagrams in Part 8 (ref. TSM7 5.10b), for example, referenceable grids.
- There are descriptions of concepts which are not supported by other parts of S-100 (especially the HDF5 encoding), such as polygonal tiles and scanned images.
- Concepts needed by product specifications under active development are not included in the conceptual model: e.g., time series information and vector features in conjunction with gridded data (needed for meta-features like S-101's *DataCoverage*).
- Support or non-support for higher-dimensional grids (greater than 2 dimensions) is ambiguous.
- There is a significant amount of background information and highly general material about gridded data, making Part 8 far more of a "tutorial" or "textbook" than other Parts of S-100, increasing the overall density of information in Part 8 without contributing much to the immediate purposes of S-100 as a framework standard[1].
- Part 8 introduces some S-100 derivations of ISO 19123 classes. Most of the S-100 derivations are not needed for the HDF5 encoding in Part 10c, which closely follows the ISO 19123 conceptual model.

---

[1] A case in point is Clause 8-5.3 "Content Model Level", which includes discussions of approaches to combining raster images with grids (Paragraph 3) and types of compression (Paragraph 4).

- The HDF5 encoding makes extensive use of embedded metadata, but Part 8 does not discuss metadata at more than a very general level (e.g., clauses 8-5.3.1, 8-8.3) and in terms of ISO 19115-1/2/3 and ISO 19157, which assume elaborately structured metadata in separate files.
- Some content is structured differently from similar content in other Parts, e.g., classes and attributes in the model are not described by means of "documentation tables" in Part 8. There are also various editorial errors (ref. TSM7 5.10b).

Note that some of the content of Part 8 is reproduced elsewhere (e.g., template application schemas for quadrilateral grids and Riemann grids in Part 3, clause 3-7).

Further, some product specifications (S-111, S-104) need to be able to encode time series data, which does not correspond to a conceptual model in S-100 Ed. 4.0.0. In principle time series could be an additional model or an extension to the GFM in Part 3 (and encoded in GML) but given that it will be part of the same products as coverage data, and therefore preferably utilize the same data formats, it is expedient to make time series models an extension to imagery and gridded data models and add them to Part 8 (changing the title of Part 8 accordingly, to "Imagery, Gridded, and Time Series Data").

Given the nature and scope of these gaps and deficiencies, a holistic review of S-100 Part 8 should be undertaken with the aim of removing extraneous content, bringing it up to date with current scope, practice and needs for coverage specifications, specifically S-102, S-111, and S-104, and correcting known discrepancies.

## Timeline

The most relevant base standards, ISO 19123 and 19129 were recently confirmed by ISO (2016 and 2019 respectively) and should remain current for the next one or two Editions of S-100 (assuming a 2-year revision cycle between S-100 Editions). ISO TC211 is working on an update to ISO 19123 (ISO 19123-1), which is targeted for publication as an ISO standard in September 2022, which probably means December 2023 at the earliest before S-100 can be revised for that edition of ISO 19123.

Other relevant ISO standards are ISO 19115-1/2/3, ISO 19157, and ISO 19123-2 which were published or recently amended in the 2016-2019 period.

The IHO and WMO Product Specifications which depend on the S-100 imagery and gridded data model are S-102, S-111, for which x.0.0 editions have been recently released; and S-104, S-412 (Weather and Wave Hazards, S-413 (Weather and Wave Conditions), and S-414 (Weather and Wave Observations), which are under development or planned in the near future.

Given what is known about the publication dates of the base standards, development efforts and stage of work for the product specifications depending on S-100 Part 8, and allowing sufficient time for the update and review cycle for S-100, a holistic review/update of Part 8 is recommended in time for S-100 Edition 5.0 or 5.1.

## Conclusions

The treatment of imagery and gridded data in S-100 needs a holistic and comprehensive review to align it with the base ISO standards as well as the HDF5 data format for gridded data. Part 8 in particular should be updated to streamline its current content, harmonize it with Part 10c (HDF5 encoding), and extend its scope to include time series data, in conformance with the scopes of S-111, S-104, and S-102 in particular.

## Actions Requested

The S-100 WG is invited to:

1) Endorse the plan for a holistic review and subsequent revision of the treatment of coverages, imagery and gridded data in S-100, focused on the conceptual model in S-100 Part 8.
2) Subject to Action 1, identify issues which should be addressed in the course of the review and revision, in addition to those listed in this paper.
3) Endorse the extension of the scope of S-100 Part 8 to include a conceptual model of time series information.
4) Identify other kinds of information that are appropriate for a revised and extended Part 8 in S-100 Edition 5 or 6.
5) Take other actions as appropriate.