Progress on the S-111 Product Specification

S-111 Project Team

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5th Tides, Water Level and Currents Working Group (TWCWG5)

Remote VTC

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In memory of Kurt Hess

- Dec 2018: **Ed 1.0.0** distributed by IHO
  - Under review by OEMs, software developers, test bed creators
- Apr 2019: TWCWG4
- Jun 2019: **Ed 1.0.1** accepted
- Sep 2019: attended 7th S-100 Test Strategy Meeting (Monaco)
- Dec 2019: **Ed 1.0.2** finalized
- Sep 2020: **Ed 1.1.0** finalized
- Mar 2021: attended 8th S-100 Test Strategy Meeting (VTC)
- **Ed 1.1.1** ready for TWCWG5

- Updates to S-111 PS (Eds. 1.0.2, 1.1.0)
- Results from S-104 work
- Changes since 7th Test Strategy Meeting (TSM7) (Ed 1.1.1)
- Issues to discuss
- Next Steps

- Review by Japan: mainly editorial

- Uncertainty name change: *surfaceCurrentSpeed*, not *surfaceCurrentUncertainty*

- Converted some data types from integer to enumeration, e.g. *interpolationType* = 10, 'discrete'

- Added Section 6.3 Validation checks:

6.3 Validation checks

Validation checks (in development) are intended for production systems designed to produce S-111 Surface Currents datasets. The checks can be administered at any time during the production phase. They can also be applied downstream in the distribution and end user systems to test the conformance of a dataset to the format rules specified in S-100 Part 10c and the S-111 Product Specification.

For example, checks will be made for: inclusion of mandated variables, variable values being within accepted ranges, inclusion of optional values when required, matches between number of array elements and array dimension specifications, timeliness of data, etc. Error severity may be, for example, that the dataset unusable, that the dataset is of degraded utility but otherwise safe to use, and that dataset has one or more small and inconsequential inconsistencies.

In Section 12.3 Product Metadata:

- Added suggestion for native integer type for enumerations (S-100WG RM comment)
  - *'It is suggested for any enumeration in S-111, to use native integer type H5T_NATIVE_UINT8 for the base type of the numeric code when creating the enumeration.'*
  - e.g. *dataCodingFormat* = **2**: Regularly-gridded arrays → '2' is an H5T_NATIVE_UINT8

- Added notes in metadata Tables 12.1, 12.2, 12.3 indicating restrictions on core metadata values that are not imposed in S-100
  - i.e. whether they are optional or mandatory, the specific values allowed, etc.
  - e.g. *timeRecordInterval* is mandatory in S-111 but optional in S-100

- *dataCodingFormat* = 1: 'Time series at fixed stations' defined differently from our original
  - S-100 organized *dcf* = 1 by time rather than by station
  - e.g. Group_001 contains all stations at time1, Group_002 all stations at time2, etc.
  - This is now corrected in S-111 PS

- Allow non-uniform time intervals (Germany request for S-104)
  - Left out of S-111 PS for now
  - **Is there an S-111 use case?**

waterLevelHeight	waterLevelTrend	waterLevelTime
1.324	0	20190703T000100Z
1.384	0	20190703T001500Z
1.438	0	20190703T003000Z

S-104 non-uniform time intervals example

- Expanded Vertical Coordinate System (*verticalCS*)
  - This was an S-100 Change Proposal accepted at S-100WG5
  - Applies to S-100 Edition 5.0.0 (2022 release)
  - Table 12.1 General Metadata (for entire HDF5 file):

13	Vertical coordinate system	verticalCS	0..1	Integer	EPSG code. Allowed values: 6489 – depth (m) oriented down 6499 – height (m) oriented up
14	Vertical coordinate base	verticalCoordinateBase	0..1	Enum.	1: Sea surface 2: Vertical datum 3: Sea bottom
15	Vertical datum reference	verticalDatumReference	0..1	Enum.	Only if verticalCoordinateBase=2 1: S-100 vertical datum 2: EPSG code
16	Vertical datum	verticalDatum	0..1	Integer	Only if verticalCoordinateBase=2. If verticalDatumReference=1, use value from S100_VerticalAndSoundingData. If verticalDatumReference=2, use the EPSG code for the vertical datum.

- Added *dataCodingFormat* = 8: 'Stationwise time series'
  - This was our S-100 Change Proposal accepted at S-100WG5 for S-104
  - *dcf* = 8 organized by station (*dcf* = 1 organized by time)
  - e.g. Group_001 contains all times for station1, Group_002 all times for station2
  - Expanded new Table 12.4 Values Group attributes and Annex F figure:

General	Attributes		
Number of attributes = 7		Add	Delete
Name	**Value**	**Type**	**Array Size**
endDateTime	20190710T000000Z	String, length = 16	1
numberOfTimes	673	16-bit integer	1
startDateTime	20190703T000000Z	String, length = 16	1
stationIdentification	8000101	32-bit integer	1
stationName	Station_Location_Alpha	String, length = 22	Scalar
timeIntervalIndex	1	32-bit integer	1
timeRecordInterval	900	16-bit integer	1

Annex F Figure F.6 - Long form of attributes of the values group 'Group_001'. Used for dataCodingFormat = 8.

- Portrayal catalogue: dusk/night colours corrected in IHO registry (KHOA S-100 viewer feedback)

- Use h5dump in addition to HDFView (SevenCs S-102 review)


```
$ h5dump -p vds.h5
HDF5 "vds.h5" {
GROUP "/" {
    DATASET "VDS" {
        DATATYPE  H5T_STD_I32LE
        DATASPACE  SIMPLE { ( 4, 6 ) / ( 4, 6 ) }
        STORAGE_LAYOUT {
            MAPPING 0 {
                VIRTUAL {
                    SELECTION REGULAR_HYPERSLAB {
                        START (0,0)
                        STRIDE (1,1)
                        COUNT (1,1)
                        BLOCK (1,6)
                    }
                }
                SOURCE {
                    FILE "a.h5"
                    DATASET "A"
                    SELECTION ALL
                }
            }
```

Entire dataset is selected

h5dump (support.hdfgroup.org)

HDFView

- File naming convention (thanks to Norway- Hilde)
  - S-111 uses 111CC (2-character producer code)
  - Then no limit on unrestricted characters
  - S-97 Guidance for PS Developers suggests 4-character producer code, and S-100WG wants 4 characters for all data products
    - S-100 needs to discuss formally moving to 4-characters (S-100 Chair)
    - **Should S-111 use 4-character producer code? Suggest yes.**

5.2.19 Dataset naming rules

Dataset naming should follow a standard pattern to give implementers greater predictability of incoming datasets. All dataset naming conventions are recommended to follow these rules as much as possible.

XXXYYYYØØØØØØØØ

XXX is the product code, for example 123 is for Maritime Radio Service; 101 for ENC.
YYYY is the producer code according to the Producer Code Register.
ØØØØ is an arbitrary length unique code in alphanumeric characters.

If useful, the Product Specification can include a differentiating character or code (for example the underscore (_) character) in the 'ØØØØ' space of the file name.

Support files should follow a similar naming.

S-97 Ed 1.1.0

- Changed fillValue from suggested '-1.0' to required '-9999.' for speed, direction (see next bullet). **Thoughts?**

- Added requirement in Group_F for:
  - *fillValue* to be '-9999.' and '-9999.' *(denotes missing data)*
  - *code* to be 'surfaceCurrentSpeed' and 'surfaceCurrentDirection'
  - *uom.name* to be 'knots' and 'arc-degrees' *(units of measurement)*

SurfaceCurrent at /Group_F/ [111US_CBOFS_20210213T00Z.h5 in C:\Users\Gregory.Seroka\Downloads]

Table

0-based

0, upper =

	code	name	uom.name	fillValue	datatype	lower	upper	closure
0	surfaceCurrentSpeed	Surface current speed	knots	-9999.	H5T_FLOAT	0.0		geSemiInterval
1	surfaceCurrentDirection	Surface current direction	arc-degrees	-9999.	H5T_FLOAT	0.0	360	geLtInterval

'Values provided here for code (surfaceCurrentSpeed and surfaceCurrentDirection), uom.name (knots and arc-degrees), and fillValue (-9999. and -9999.) are required.'

- Test bed feedback (U.S. NIWC) suggests requiring same code, uom.name, and fillValue for all S-111 datasets. **Thoughts?**

NEXT STEPS

S-100 Readiness Levels

- Incorporate TWCWG5 comments
- Work towards Ed 2.0.0

Required Product Specification component	Level 1 v1.0.0	Level 2 v1-2.0.0	Level 3 >v2.0.0	Level 4 >v2.0.0	Level 5 >v2.0.0
Main Document (Defines the relevant parts of S-100 that are required for the Product Specification)	X	X	X	X	X
A Default Encoding	X	X	X	X	X
S-100 Compliant Feature Catalogue	X (draft)	X (updated)	X (final, from IHO GI Registry)	X	X
Data Classification and Encoding Guide	X (draft)	X	X (final)	X	X
S-100 Compliant Portrayal Catalogue NOTE: Not every Specification will need a Portrayal Catalogue – this should be determined as part of the development process and stakeholder feedback.		X	X	X	X
Data Quality Checks		X	X	X	X
Test Data Sets		X	X	X	X
Data Validation (and test datasets)		X	X	X	X
Exchange Catalogue		X	X	X	X
Encryption / Digital Signatures			X	X	X
Interoperability			x* (draft)	X* (tested)	X*
Alerts and Indications				X*	X*
Operational data					X

(X* = ECDIS only)

International Hydrographic Organization

NEXT STEPS (CONT'D)

S-100 Readiness Levels

- Data quality checks
  - Expand 6.1-6.2, Annex D
  - HOs develop software
- Validation
  - S-111 rules written for S-100, need to add to S-111 6.3
  - HOs develop software, but S-100 may need to coordinate
- Exchange datasets
  - In S-111 Section 11, 12, but S-100 metadata undergoing update (2022)
  - HOs develop software: U.S. could share code

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S-100 Compliant Feature Catalogue	X (draft)	X (updated)	X (final, from IHO GI Registry)	X	X
Data Classification and Encoding Guide	X (draft)	X	X (final)	X	X
S-100 Compliant Portrayal Catalogue NOTE: Not every Specification will need a Portrayal Catalogue – this should be determined as part of the development process and stakeholder feedback.		X	X	X	X
Data Quality Checks		X	X	X	X
Test Data Sets		X	X	X	X
Data Validation (and test datasets)		X	X	X	X
Exchange Catalogue		X	X	X	X
Encryption / Digital Signatures			X	X	X
Interoperability			x* (draft)	X* (tested)	X*
Alerts and Indications				X*	X*
Operational data					X

(X* = ECDIS only)

- Respond to requests arising from implementation by test bed creators and OEMs (fillValue feedback so far)

- Nautical Chart Working Group (NCWG) can review portrayal conflicts with S-101

- Possibly improve portrayal: windy (WR Systems/Ed Weaver working on it but S-100 changes needed)
  - KHOA S-100 viewer example at TSM7/TSM8

- Ensure compliance with S-100 Ed 5.0.0
  - e.g. UML, discovery metadata
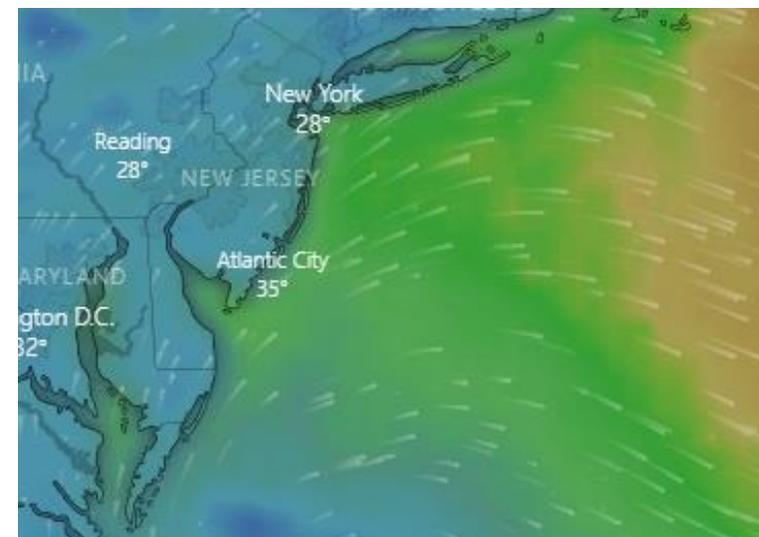
Windy.com sample display of winds