S-100 and NOAA's Precision Navigation Services

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S-100 – the IHO building blocks

- *Provides the **data framework** for the development of the next generation Electronic Navigational Charting products, as well as other digital products required by the hydrographic, maritime and GIS communities*

Who is developing S-100 product specifications

ENC
Bathymetry
Water
Levels
Surface
Currents
MPAs
UKC

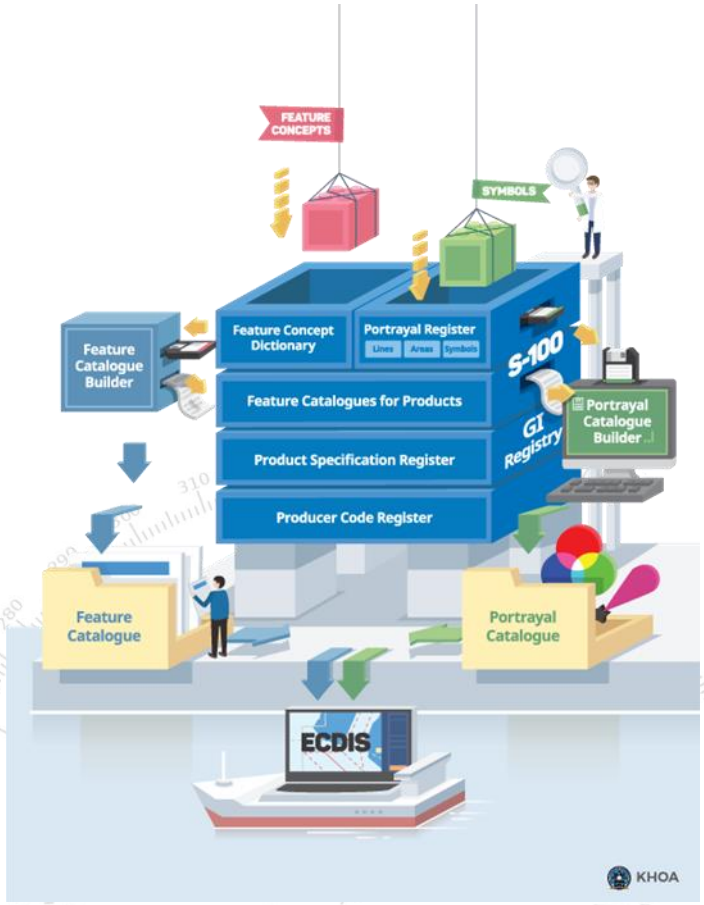
S-20x

S-421 –
Route
Exchange

S-411 -
Ice
S-412 -
Weather

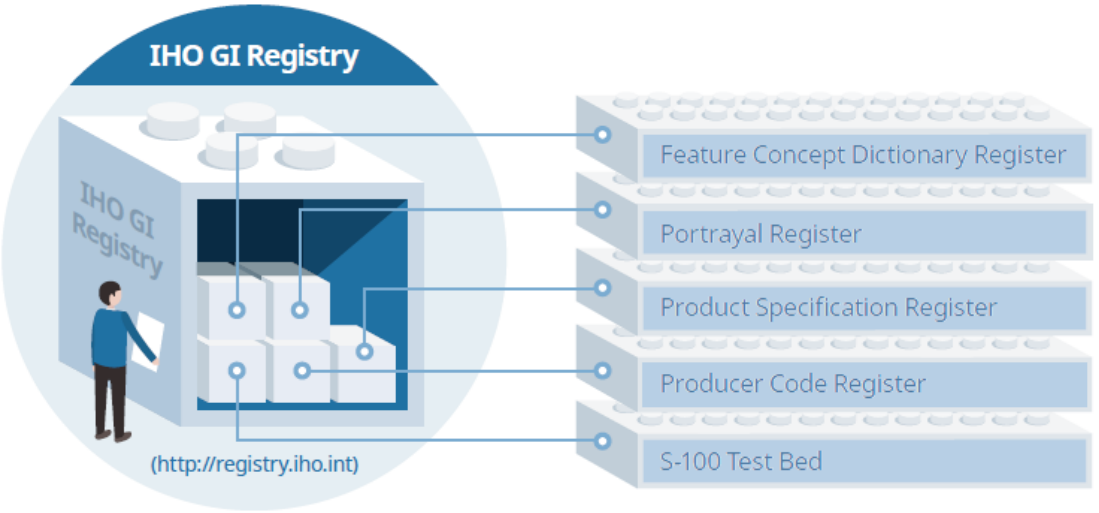
What does S-100 mean for the Maritime Community?

- Leads to a global consistency of products
- Specifies encoding formats based on product type
  - ISO 8211
    - S-101 ENCs
  - HDF5
    - S-102 Bathymetry
    - S-111 Surface Currents
    - S-104 Water Level Information
    - S-412 Gridded Weather Information
  - GML
    - S-412 Vector Weather Information
    - S-122 Marine Protected Areas
- Moves to machine readable catalog mechanism
  - XML Based Catalogues

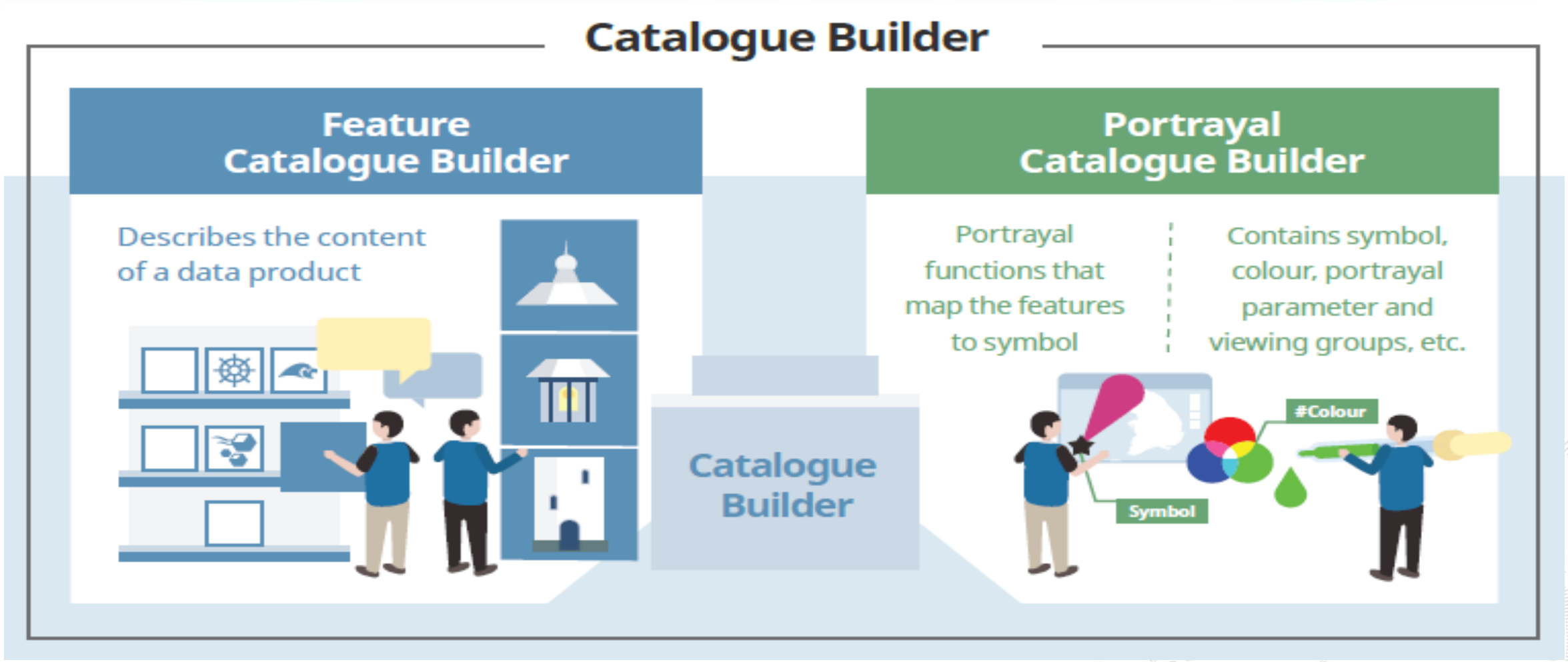


S-100 Backbone – Geospatial Information Registry

- Contains a collection of harmonized information divided into a series of registers
  - Feature Concept Dictionary – subdivided into different domains
    - Hydro
    - IALA
    - WMO
    - IEC
  - Portrayal Registers



S-100 Backbone – Catalogue Builders



S-100 Based Feature Catalogues

- Machine Readable .xml catalogue
- Binds features and attributes
- Ties in spatial primitives – Point, Curve and Surface.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S-100 Based Portrayal Catalogues

- Machine Readable set of symbols and portrayal rules
- S-100 defines two types of portrayal mechanisms
  - LUA – used for S-101 portrayal and best for portrayal rules that need to use external conditions to generate the portrayal (ship's draft)
  - XSLT – simplified rules based on XML style sheets
- Navigation Systems MUST implement both

S-100 Discovery Metadata

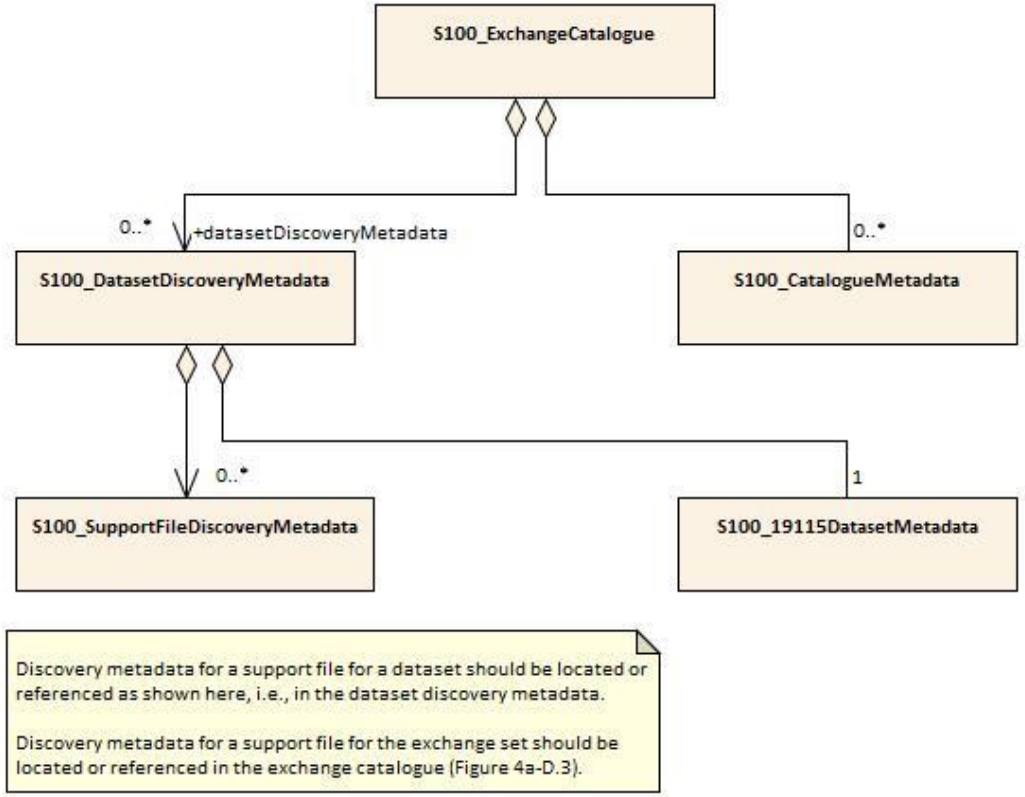
- Discovery metadata allows for automated tools to discover the semantics of the data within the datasets
- S-100 Metadata is a profile of ISO 19115-3:2016
  - S100_Metadata specializes the MD_Metadata class from ISO 19115
    - Makes metadataIdentifier mandatory
- Validated via the S100 XML Schema Definition and the S-100 Schematron Metadata Rules

S-100 Discovery Metadata – Information Exchange

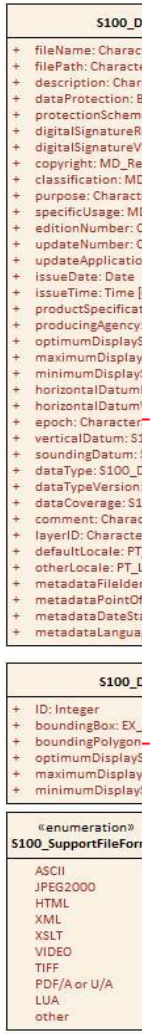
- Implemented utilizing XML exchange catalogues
- Contains:
  - Metadata about the overall exchange catalogue
  - Metadata about the individual datasets
  - Metadata about the support files that make up the package
- At the S-100 level most everything is optional
  - Restrictions may occur at the product specification level
  - Not every specification uses every field

S-100 Exchange Set Catalogue

- How datasets are packaged up and delivered
  - Usually a .zip
- XML Instance
- Sections:
  - Catalogues (Feature, Portrayal)
  - Datasets
- Subsections
  - Support files



S-100 Disc

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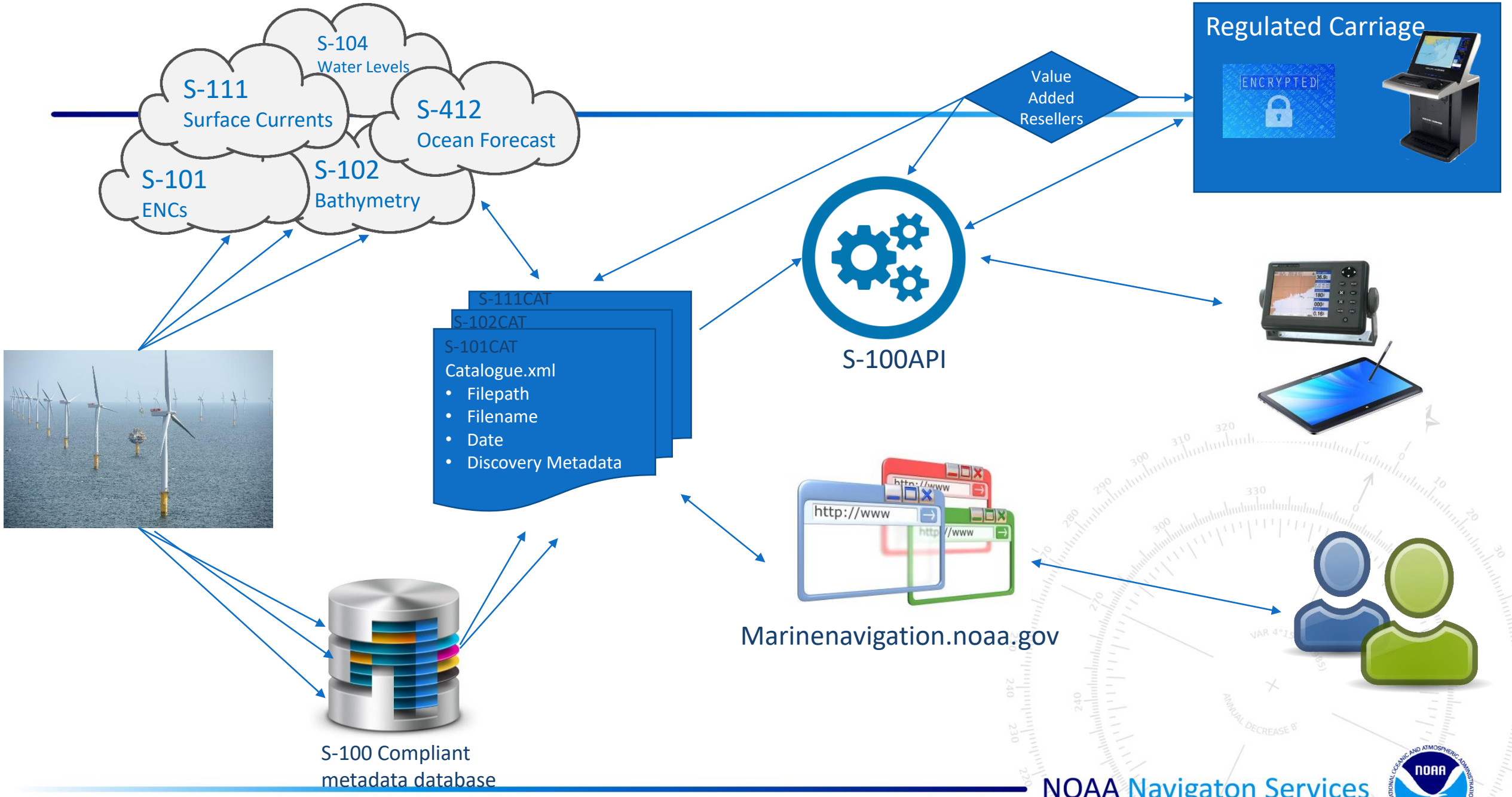
```

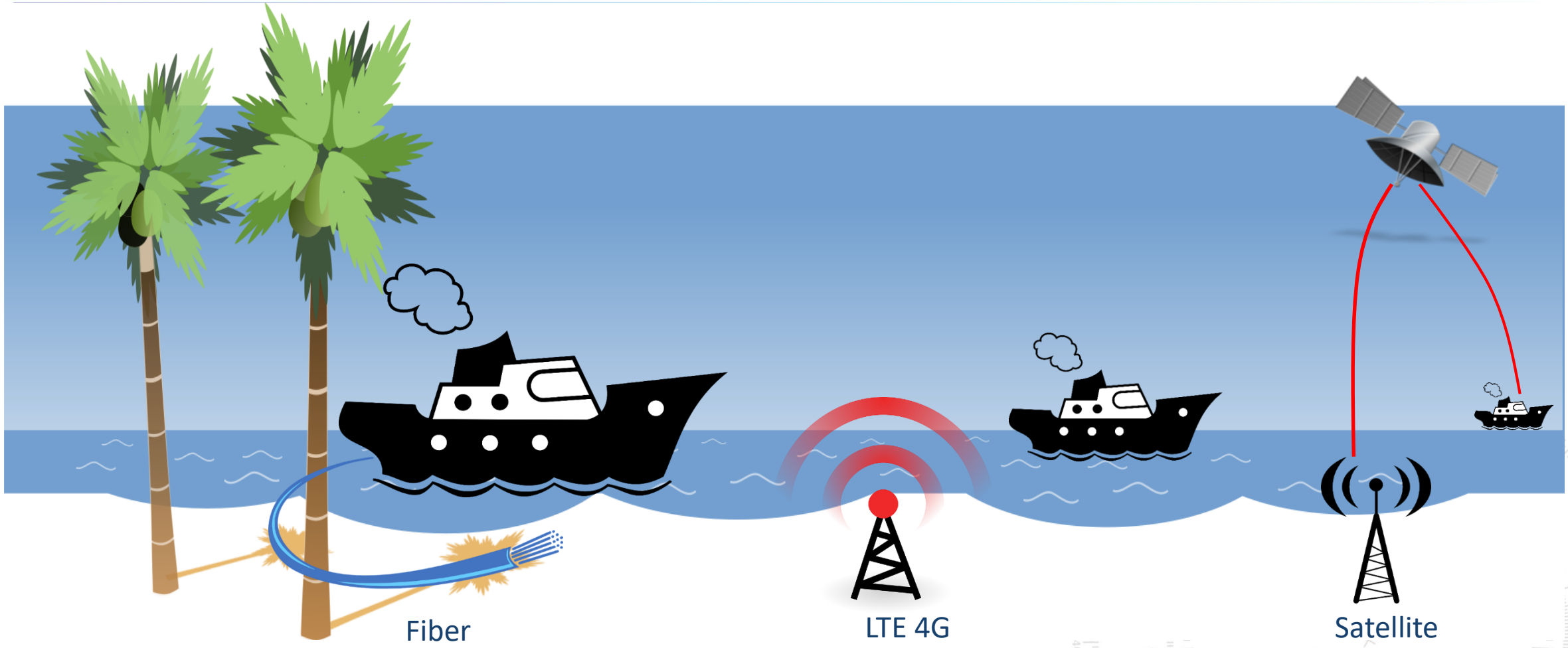
Discovery for Dissemination

- Building out a central metadata database to handle the dataset metadata
- XML allows for discovery:
  - When new data is released
  - Where the data is stored
  - Where the data is geographically
  - What type of data it is
  - Who produced the data



NOAA Navigaton Services

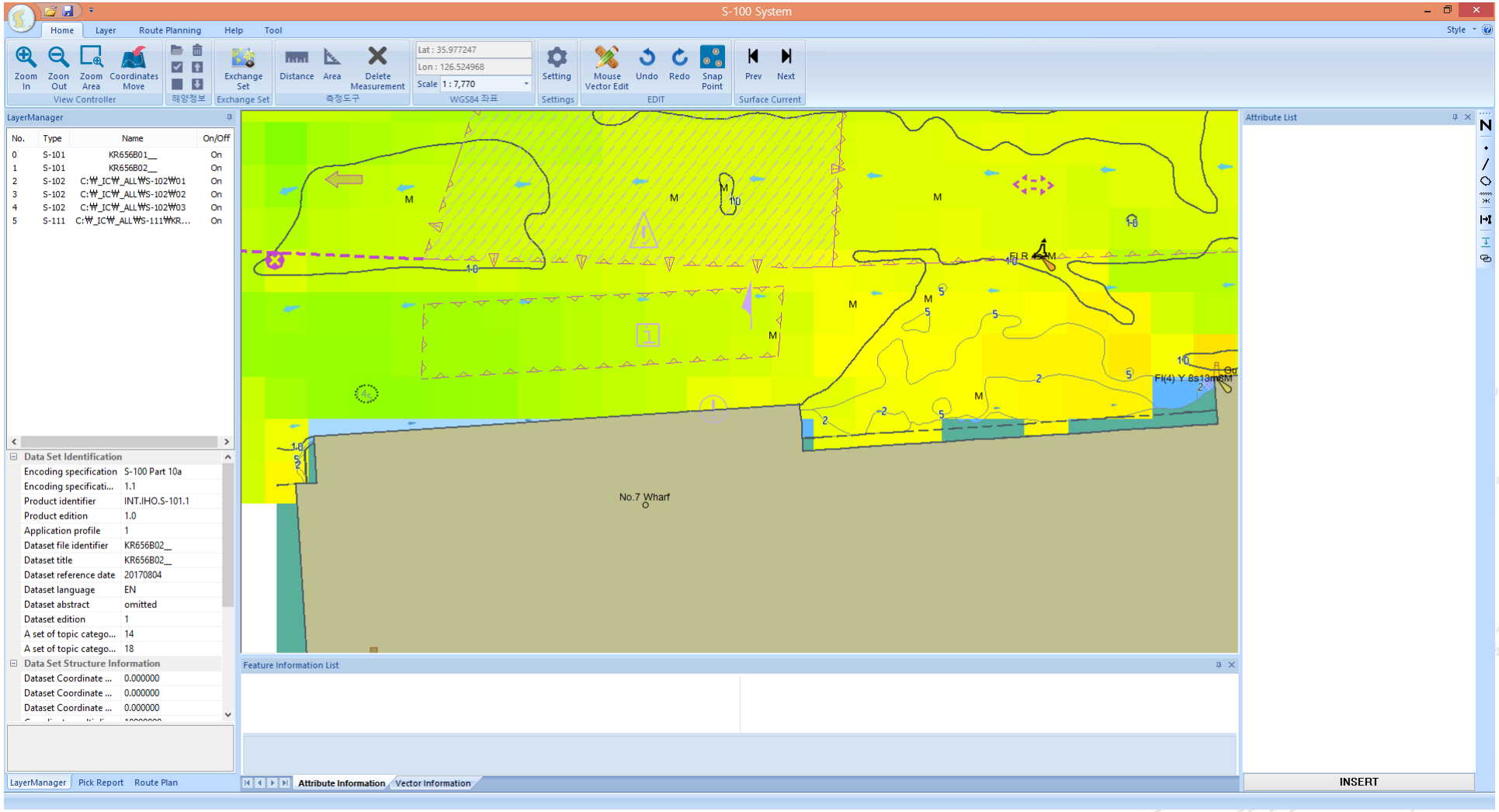
A little about Data Dissemination



S-98 – S-100 Interoperability for Navigation Systems

- Framework for capturing interoperabity rules for use in ECDIS and “front of bridge” systems
- Machine readable mechanism for rules
- Harmonized graphical presentations of S-100 data products

We want this


S-100 System
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Layer
Route Planning
Help
Tool
Zoom In
Zoon Out
Zoom Area
Coordinates Move
View Controller
Exchange Set
Distance
Area
Delete Measurement
Lat : 35.977247
Lon : 126.524968
Scale 1 : 7,770
Setting
Mouse Vector Edit
Undo
Redo
Snap Point
Prev
Next
Surface Current
LayerManager
No. Type Name On/Off
0 S-101 KR656B01__ On
1 S-101 KR656B02__ On
2 S-102 C:₩_IC₩_ALL₩S-102₩01 On
3 S-102 C:₩_IC₩_ALL₩S-102₩02 On
4 S-102 C:₩_IC₩_ALL₩S-102₩03 On
5 S-111 C:₩_IC₩_ALL₩S-111₩KR... On
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Product edition 1.0
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Dataset edition 1
A set of topic catego... 14
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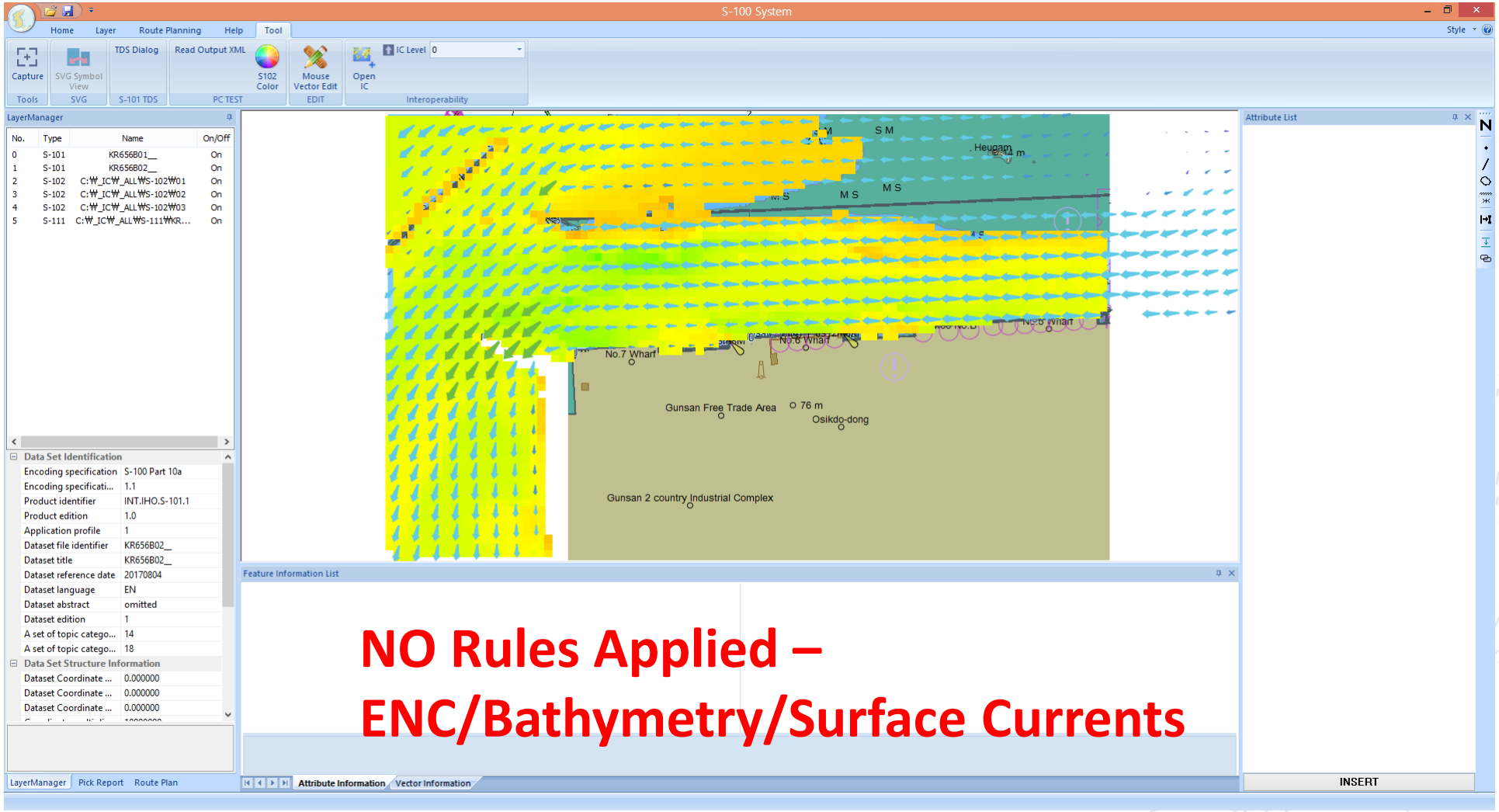
Attribute List
Feature Information List
Attribute Information
Vector Information
LayerManager
Pick Report
Route Plan
INSERT

Not THIS!

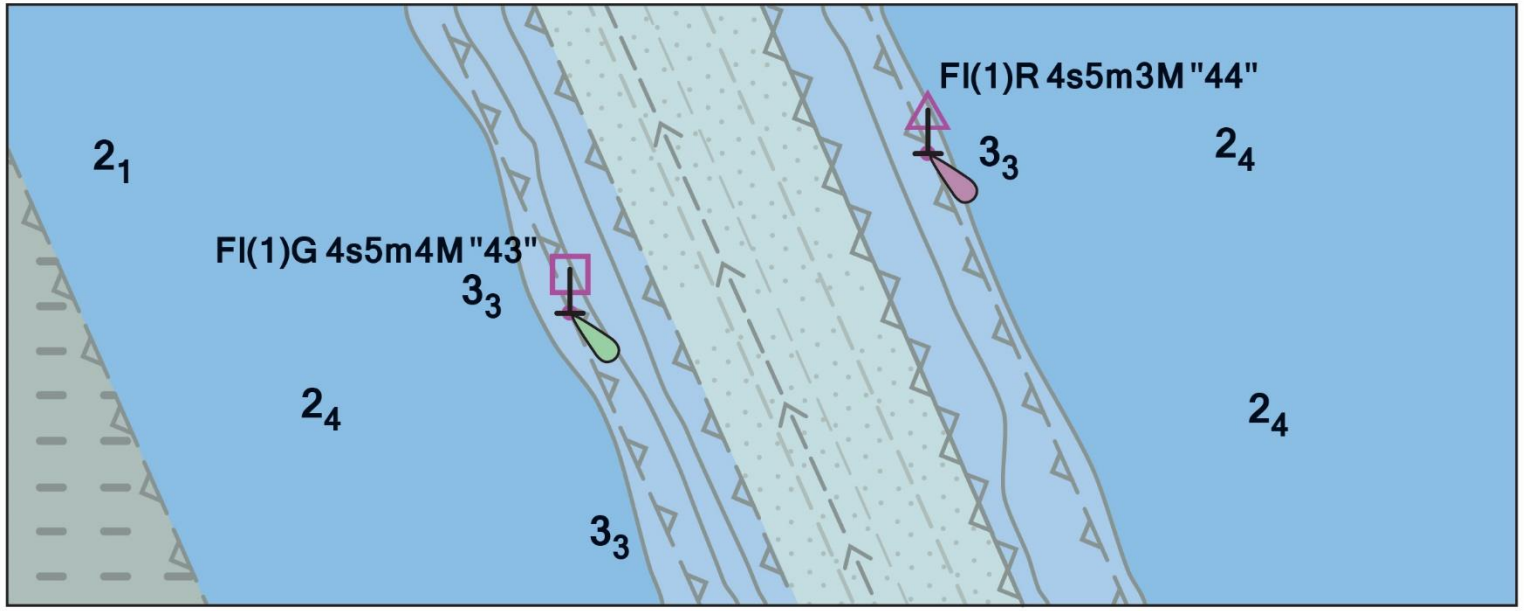


NO Rules Applied –
ENC/Bathymetry/Surface Currents

S-100 Product Development

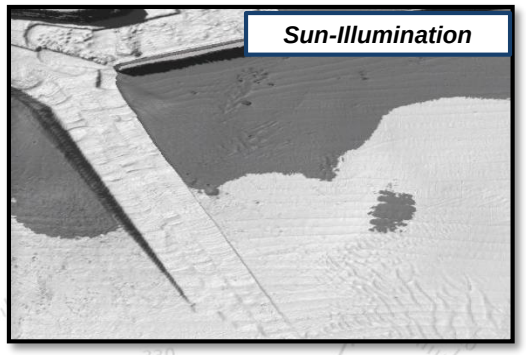
S-101 Electronic Navigational Charts

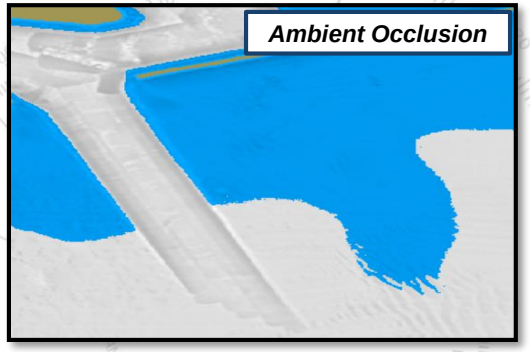
- Improved Data Modeling
- Machine readable catalogues
- NOAA and ESRI developed an S-57 to S-101 Convertor
- S-101 Edition 1.0.0 published December 2018
  - Testing Edition for system implementers



S-102 High Resolution Bathymetry for Navigation Systems

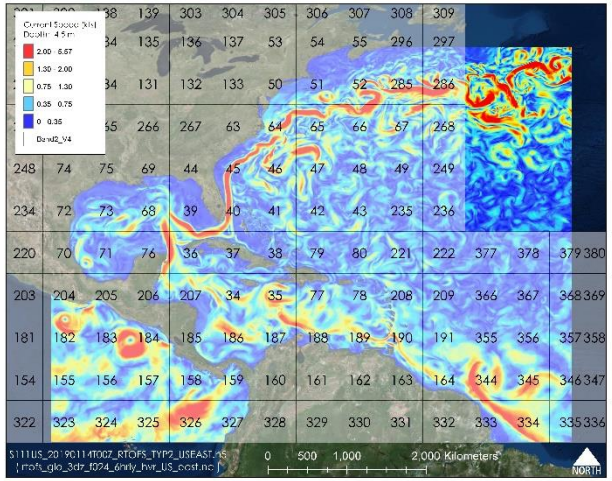
- Finalization of Edition 2.0.0 expected to be released in late 2019
- NAVOCEANO and NOAA provided a BAG to S-102 convertor program – available Sept 2019
- Post Edition 2.0.0
  - Full display in both S-100 Test Beds.
    - Korean (KHOA) and U.S. (SPAWAR)
  - Finalization of Colour scheme and surface texturing.
    - Sun-Illumination
    - Ambient Occlusion
  - Improved alignment of specification with Member State production capabilities.

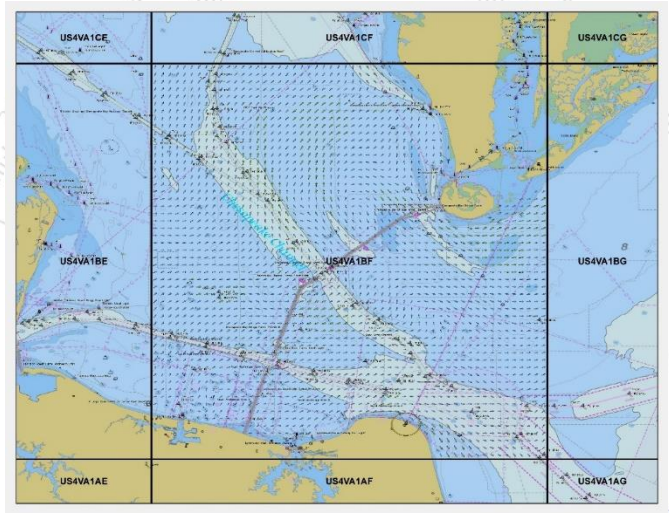




S-111 Surface Currents - Operationalization

- S-111 Edition 1.0.0 Published December 2018
- Develop a service to disseminate OFS surface current data in IHO's S-111 format
- Ability to use in Navigation Systems
- Designed for interoperability within the S-100 framework
- Implementing Machine to Machine Data Discovery





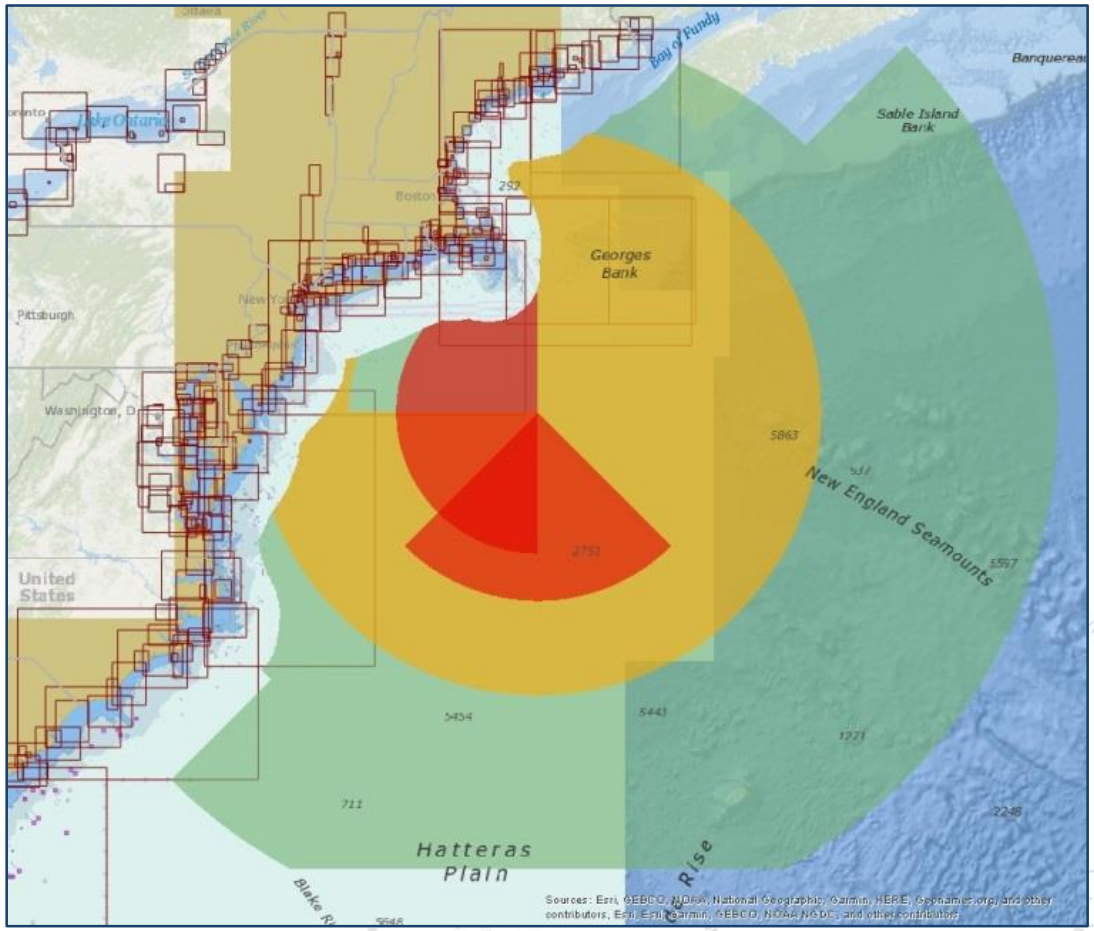
S-412 Weather and Wave Hazards

Weather Messages

- Weather message
- Tropical cyclone messages
- Thunderstorm message
- High wind message
- Freezing spray message
- Reduced visibility message
- Large seas message
- Precipitation message
- Temperature message

Weather Systems

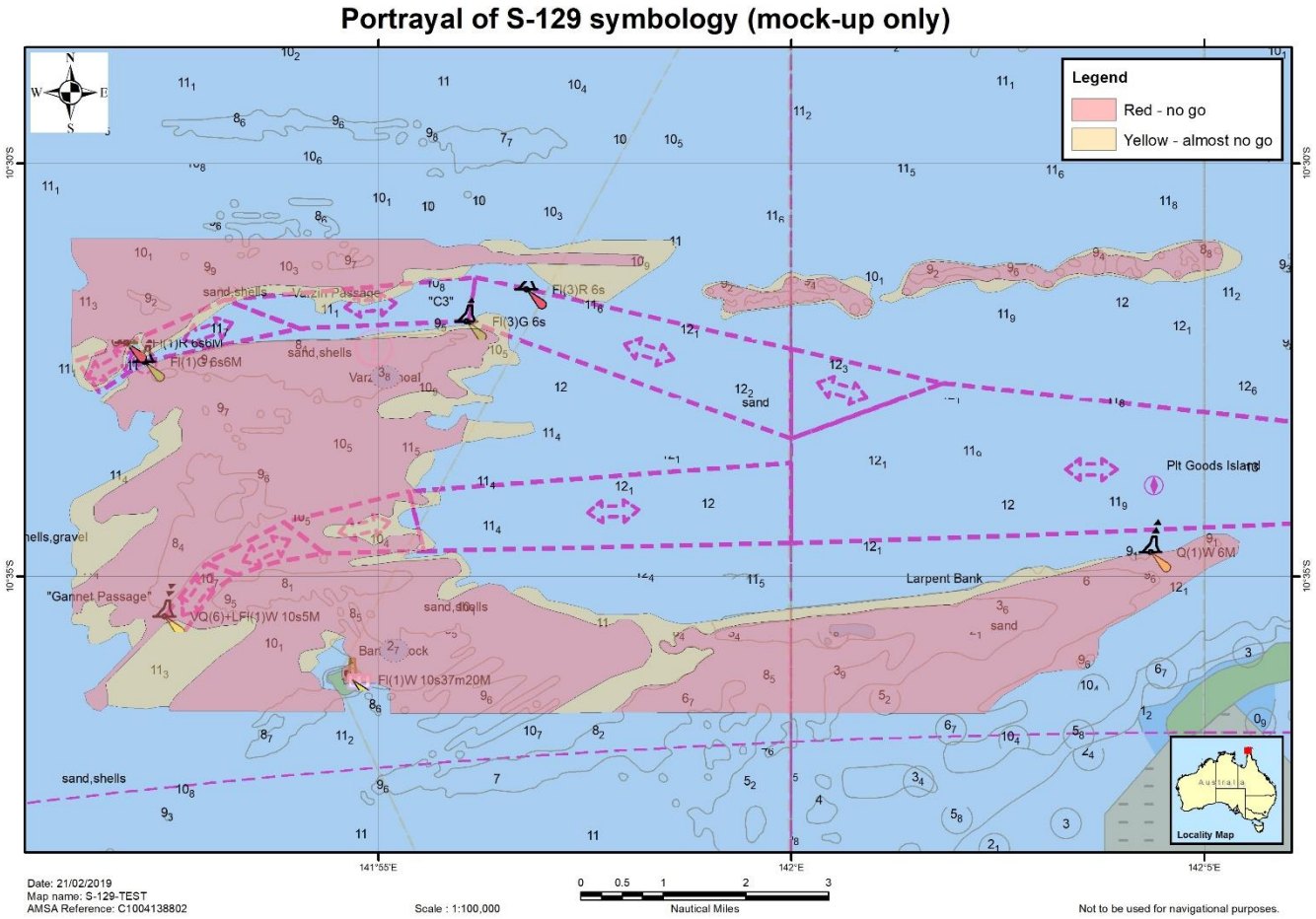
- Tropical cyclone
- Low
- Convergent Boundary
- Front
- Ridge
- Squall
- Thunderstorm
- Cyclone Track
- Cone of Uncertainty



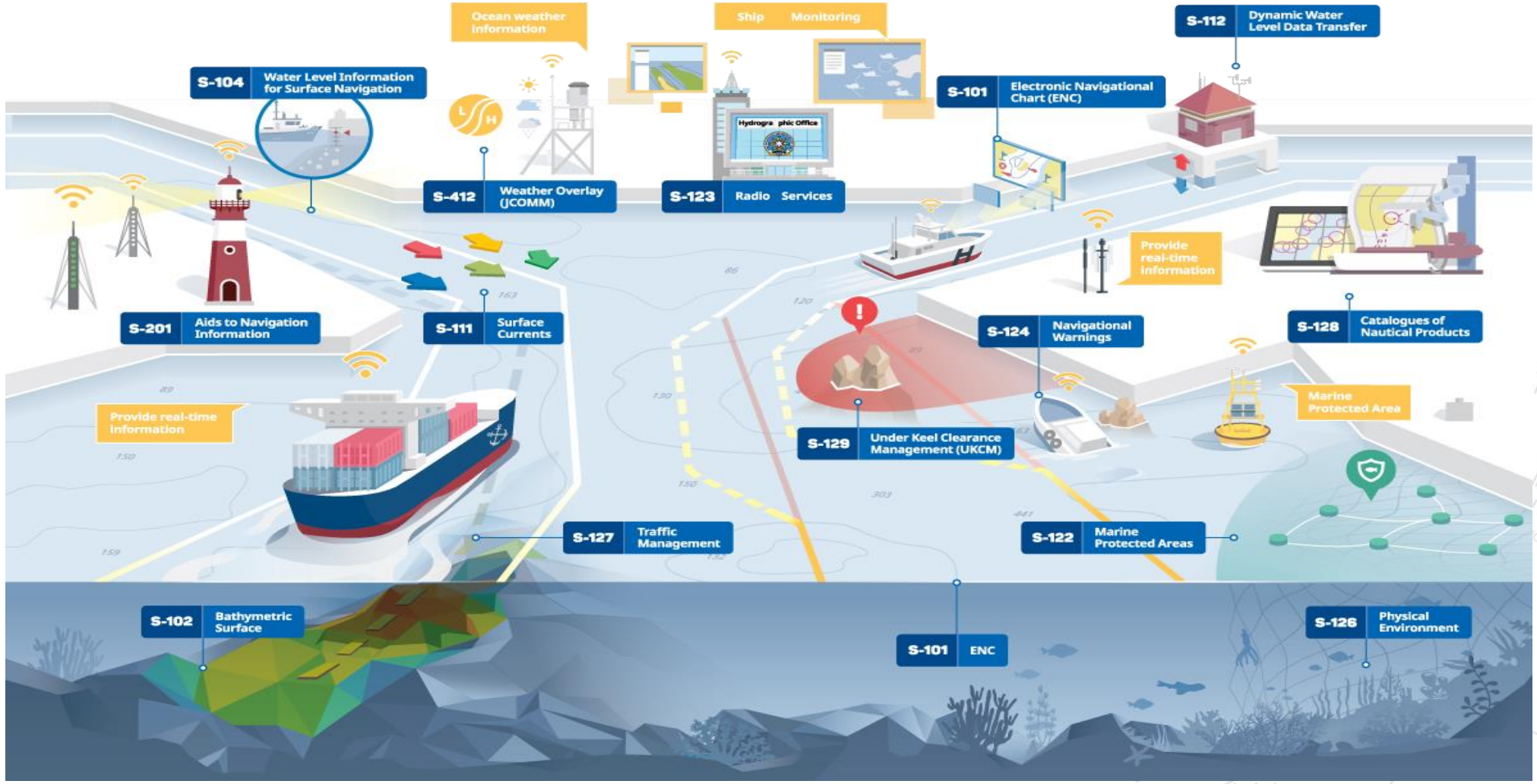
- Future Specifications include
  - Weather and Wave Conditions
  - Weather and Wave Observations

On the Horizon

- **S-104 Water Level**
  - Predicted and Real Time?
  - Currently under development by the IHO
- **S-129 Underkeel Clearance Management**
  - Depicts go/no go areas based on inputs in UKC systems from bathymetry, surface currents and water levels
  - Edition 1.0.0 anticipated in late 2019



Key Takeaways

- Standards are the building blocks to Precision Navigation
  - Harmonization of data
  - Improved interoperability
  - But …. They do take time
- If data producers move to leveraging consensus based standards it can lead to lower implementation costs for the manufacturer
  - Can lead to lower cost for the consumer
  - Can lead to increased uptake of the product

The World of S-100