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

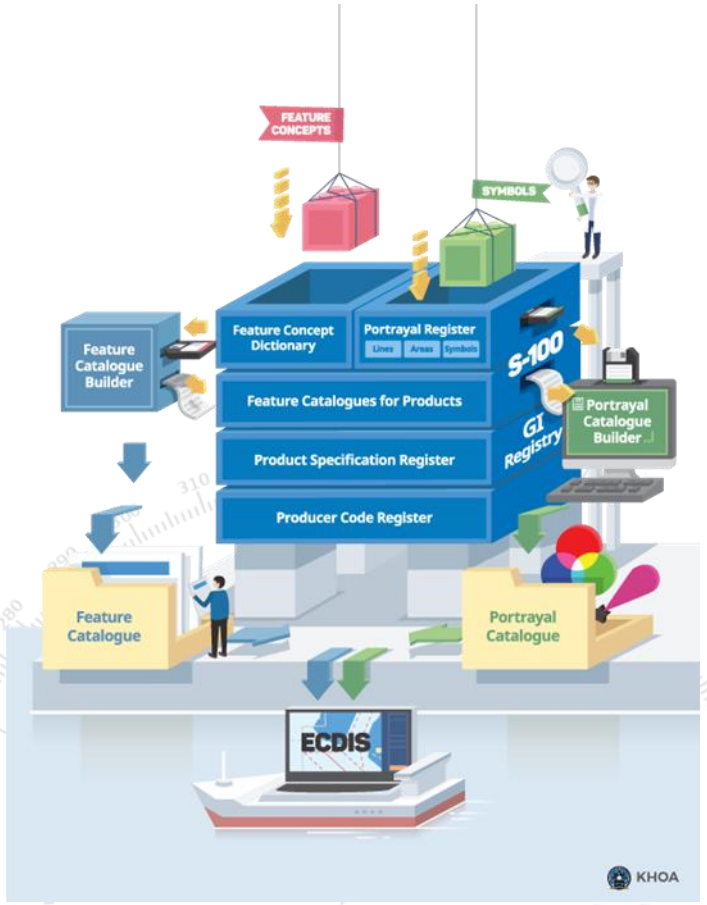
S-20x

S-421 – Route Exchange

S-411 - Ice
S-412 - Weather

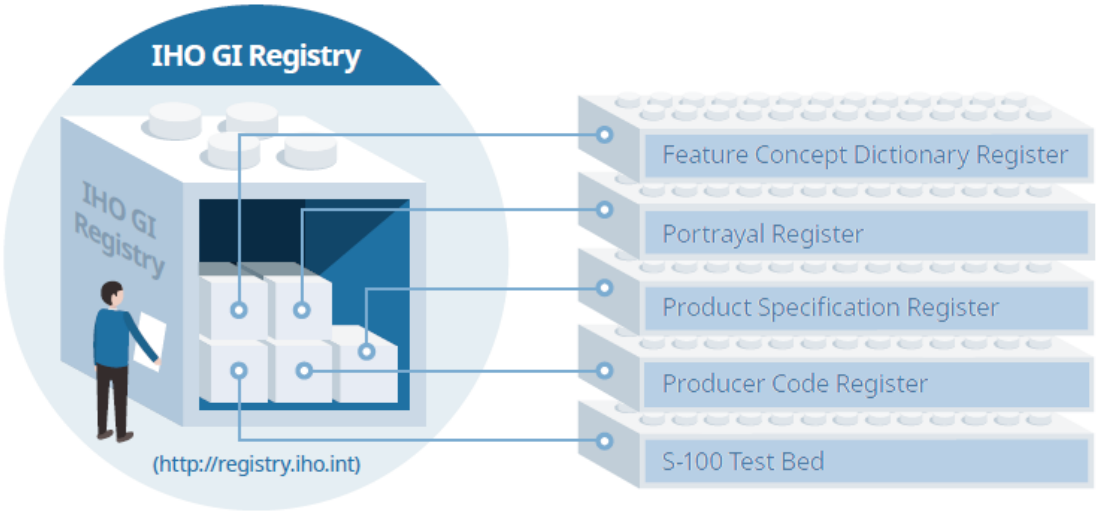
What does S-100 mean for the Maritime Community?

- 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

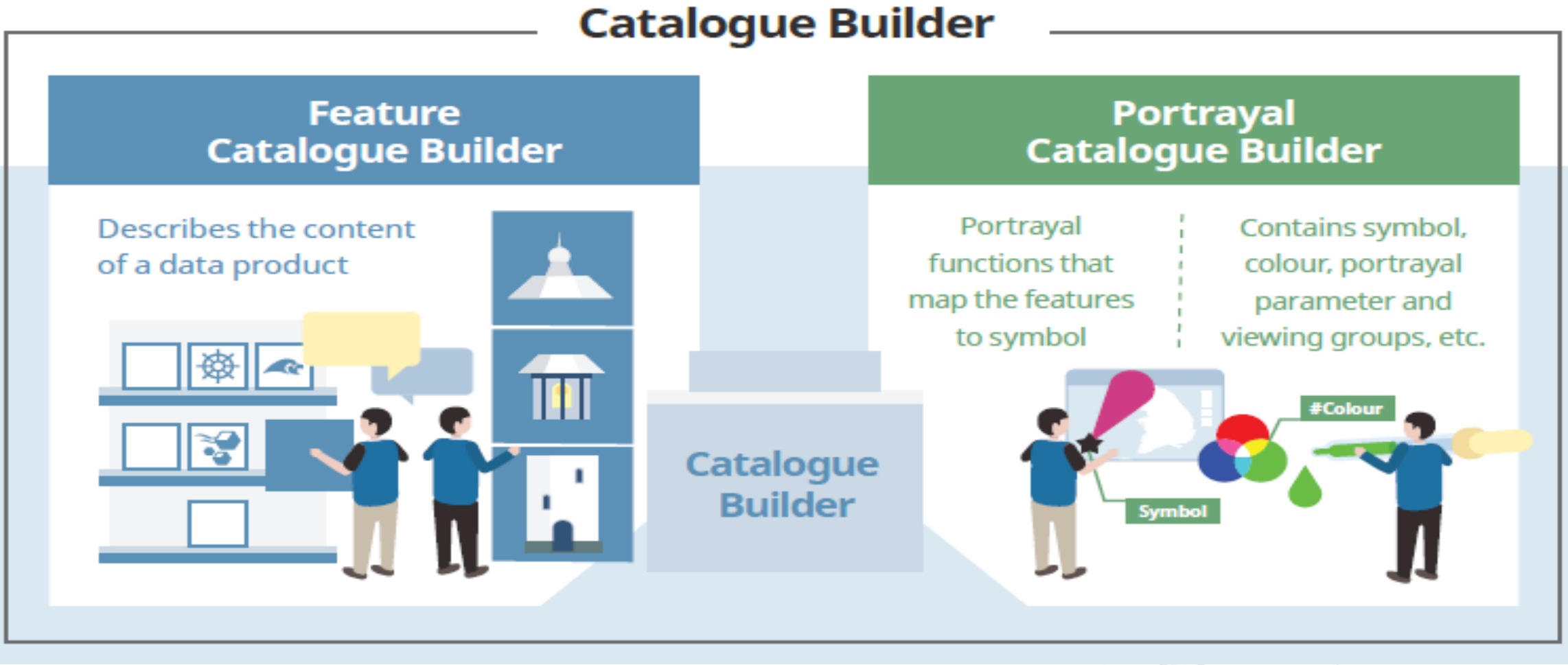


S-100 Backbone – Geospatial Information Registry

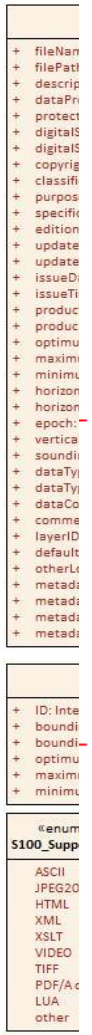
- Contains a collection of harmonized information divided into a series of registers
  - Feature Concept Dictionary – subdivided into different domains
    - Hydro
    - IALA
    - WMO
    - IEC
  - Portrayal Registers



S-100 Backbone – Catalogue Builders



S-100 Disc



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vices

S-100 Readiness Levels

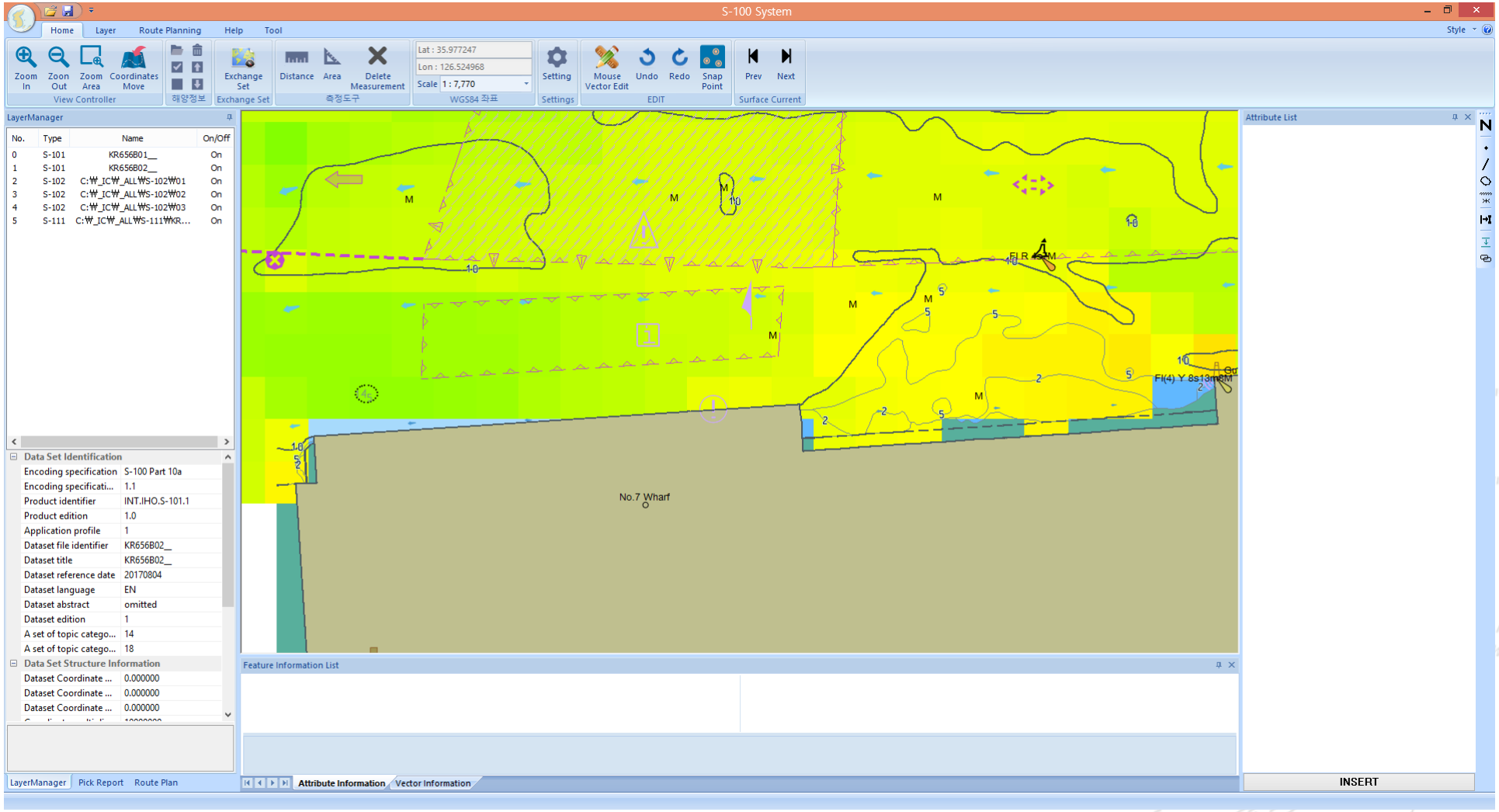
- Adapted from NASA TRL
- Readiness for operational use
- Allows non-IHO stakeholder organizations to gauge when their development meets an appropriate readiness level for transition to live operation

Required product specification component	(TRL5) Level 1 v1.0.0	(TRL6) Level 2 v1-2.0.0	(TRL7) Level 3 >v2.0.0	(TRL8) Level 4 >v2.0.0	(TRL9) 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	X	X	X	X
DCEG	X	X	X	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	X[1]
Alerts and Indications				X	X[1]
Operational data					X

S-98 – S-100 Interoperability for Navigation Systems

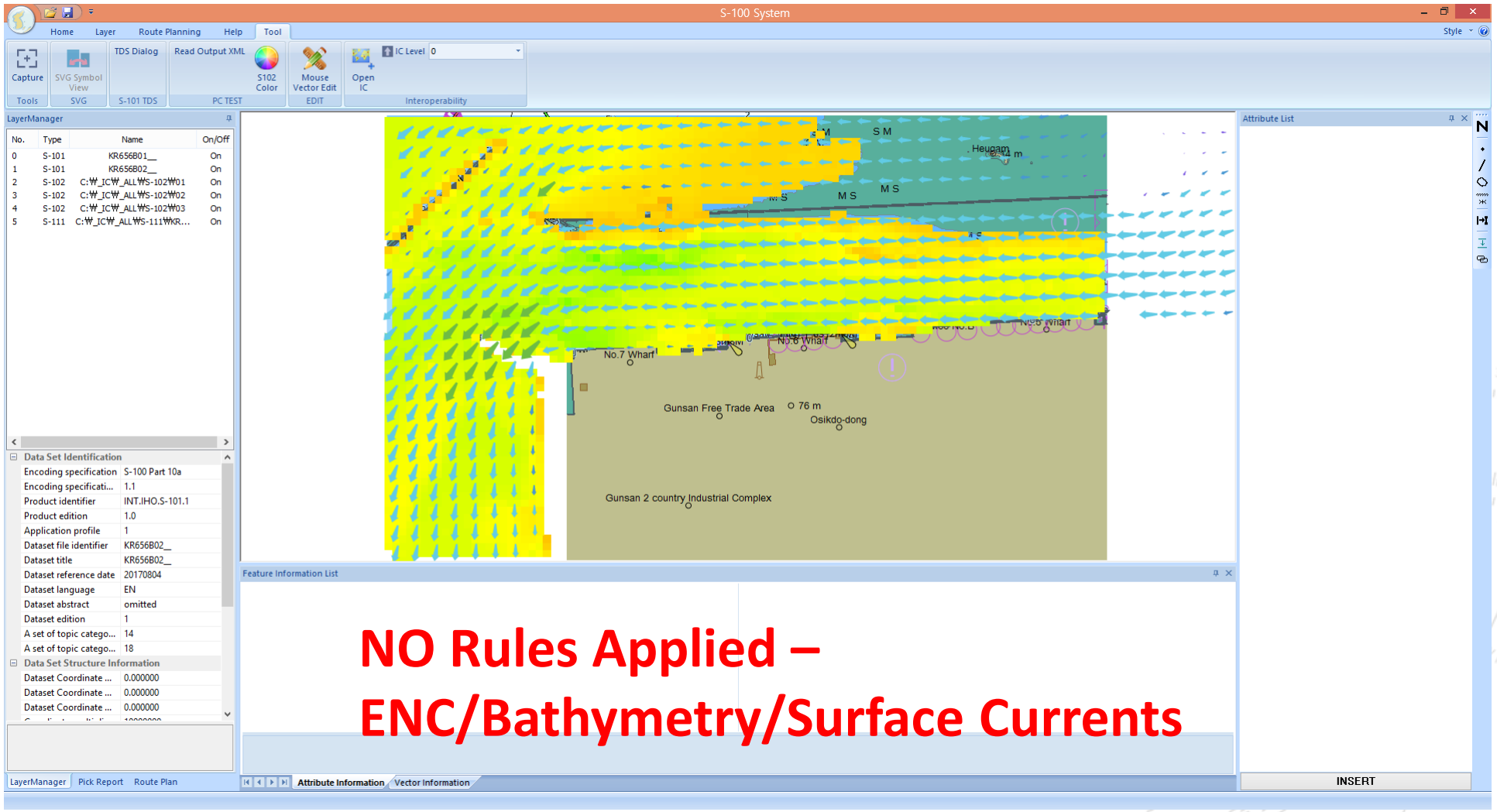
- Framework for capturing interoperabity rules for use in ECDIS and “front of bridge” systems
- Machine readable mechanism for rules
- Harmonized graphical presentations of S-100 data products

We want this



NOAA Navigaton Services

Not THIS!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Layer
Route Planning
Help
Tool
Capture
SVG Symbol View
TDS Dialog
Read Output XML
S102 Color
Mouse Vector Edit
Open IC
IC Level
Tools
SVG
S-101 TDS
PC TEST
EDIT
Interoperability
LayerManager
No.
Type
Name
On/Off
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No.6 Wharf
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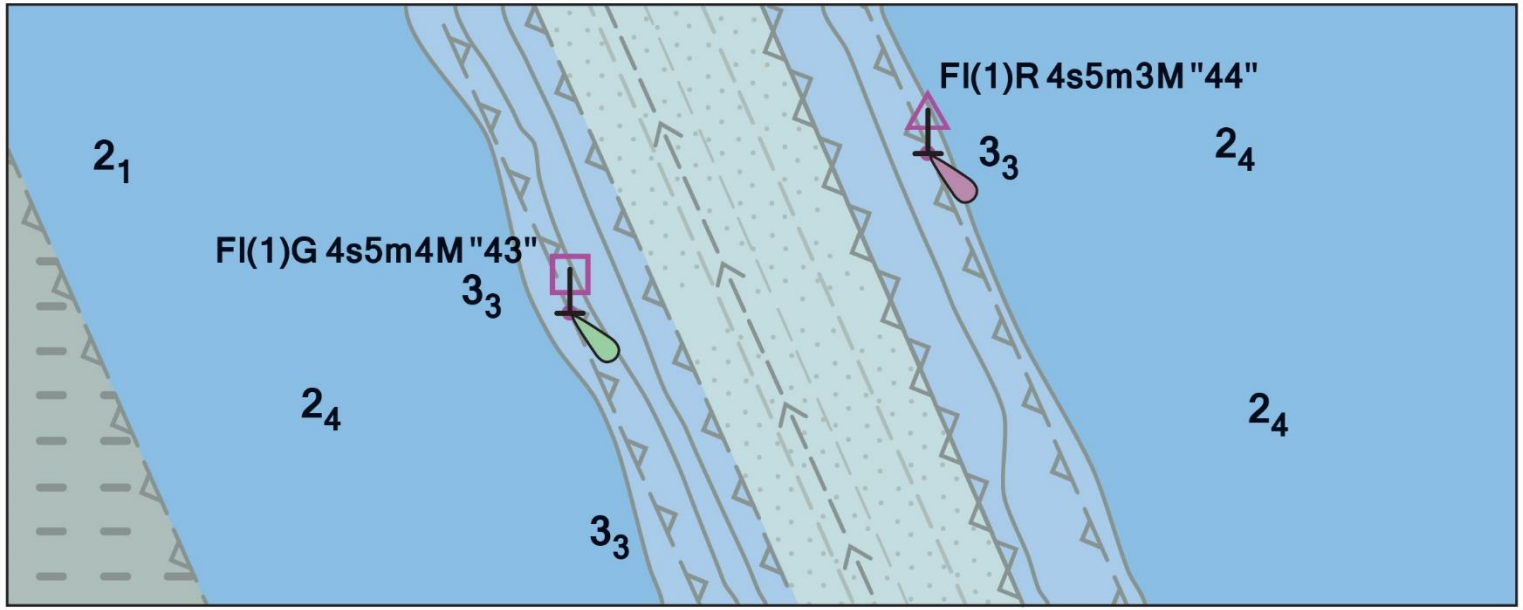
Gunsan 2 country Industrial Complex
Attribute List
Feature Information List
NO Rules Applied –
ENC/Bathymetry/Surface Currents
LayerManager
Pick Report
Route Plan
Attribute Information
Vector Information
INSERT

S-100 Product Development

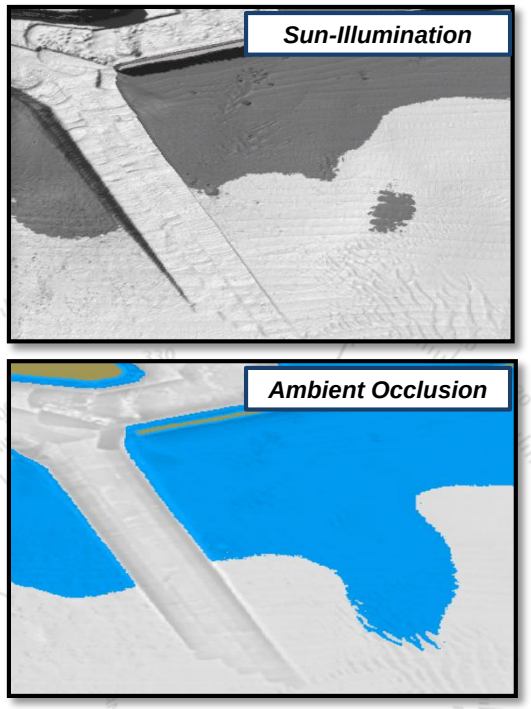
S-101 Electronic Navigational Charts

- 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



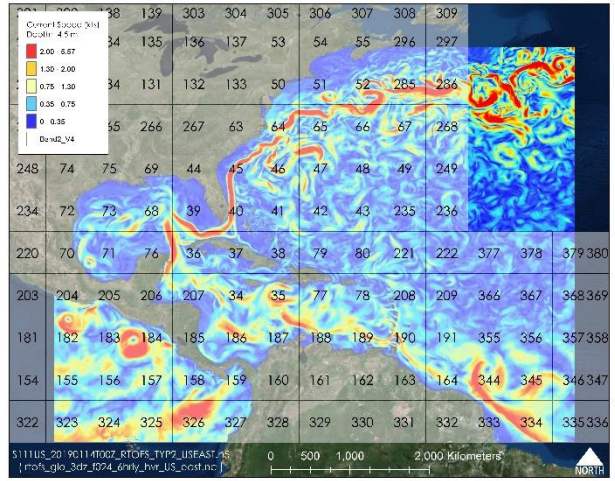
S-102 High Resolution Bathymetry for Navigation Systems

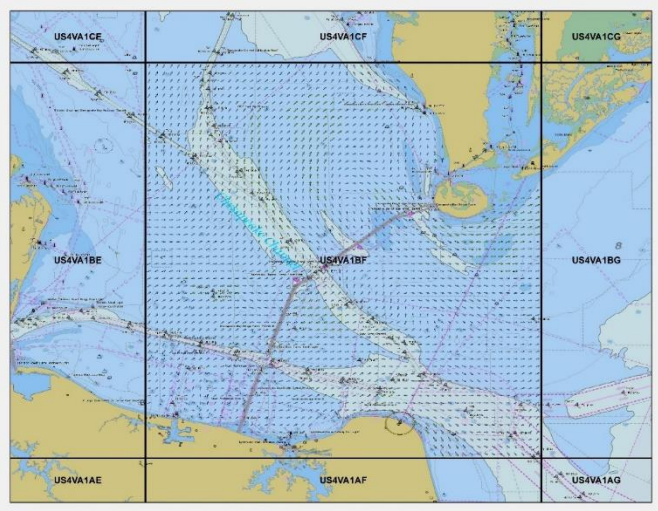
- Finalization of Edition 2.0.0 expected to be released in late 2019
- NAVOCEANO and NOAA provided a BAG to S-102 convertor program
- Post Edition 2.0.0
  - Full display in both S-100 Test Beds.
    - Korean (KHOA) and U.S. (SPAWAR)
  - Finalization of Colour scheme and surface texturing.
    - Sun-Illumination
    - 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





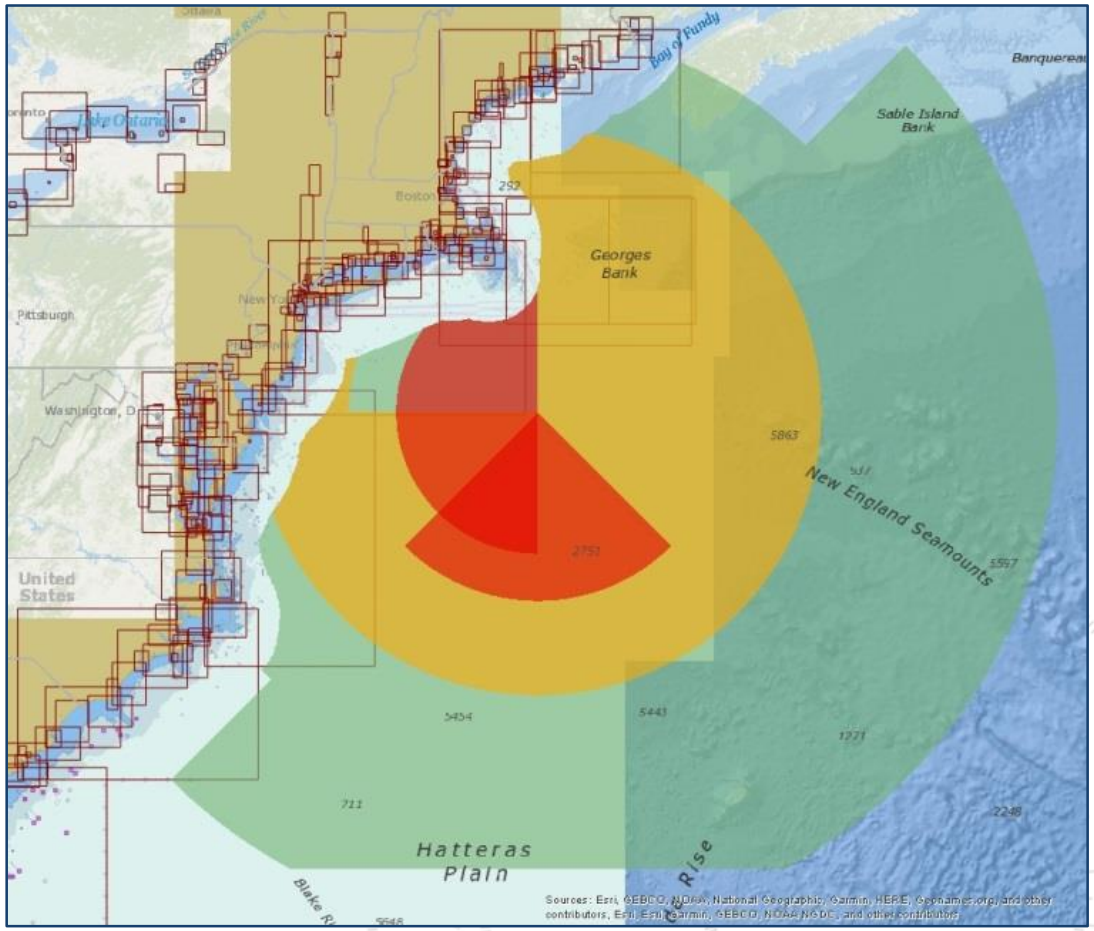
S-412 Weather and Wave Hazards

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

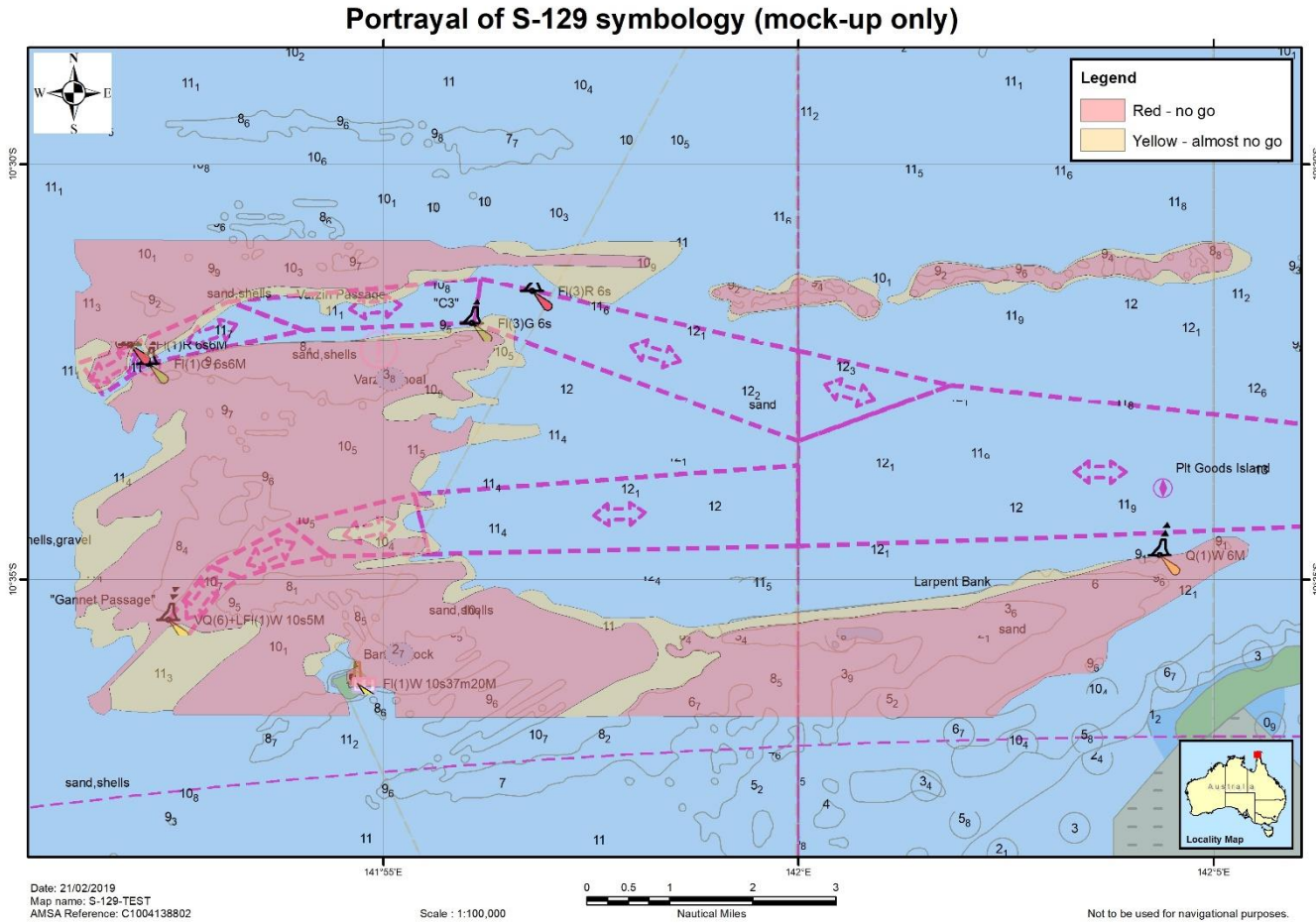


- Future Specifications include
  - Weather and Wave Conditions
  - Weather and Wave Observations

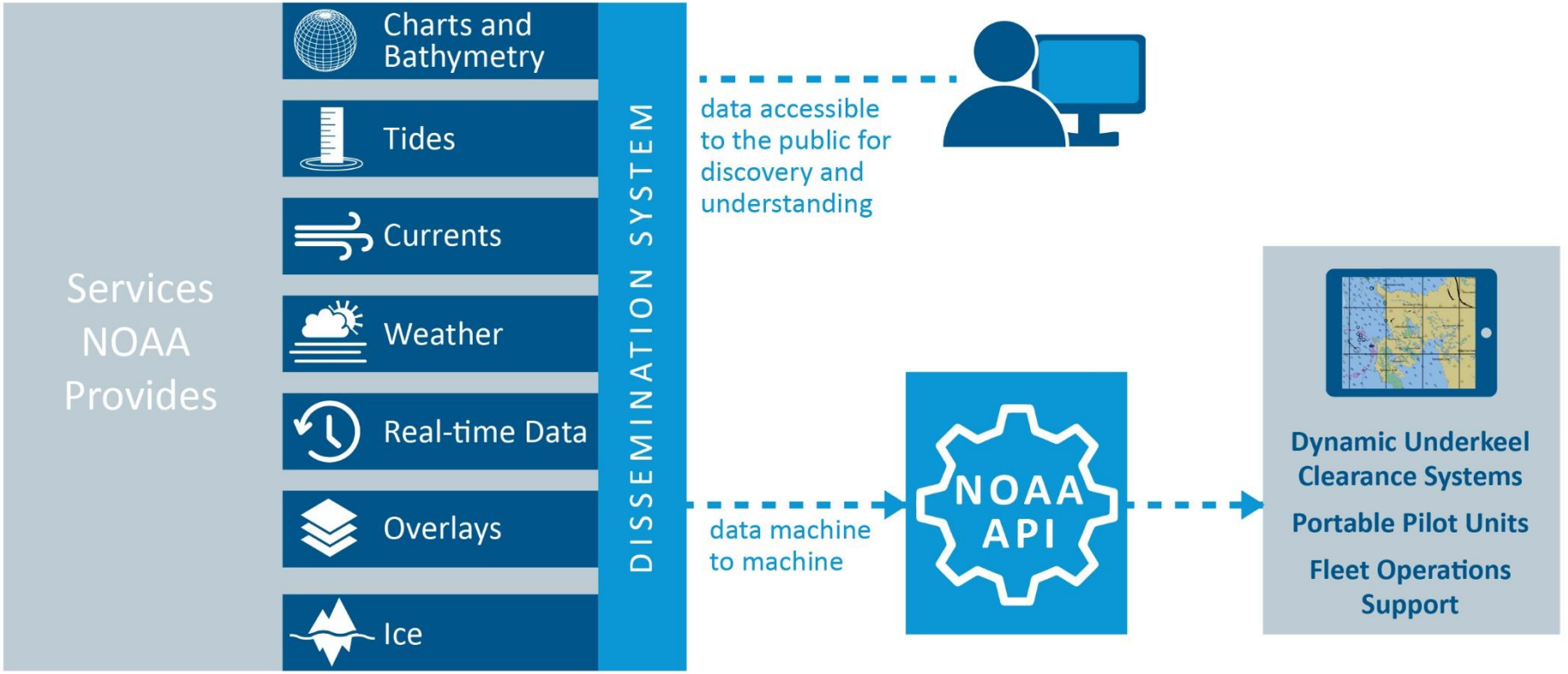
On the Horizon

- **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



NOAA's Precision Navigation



Precision Navigation – Economic Benefits

- Single streamlined decision support tool to
  - Optimizes the available channel depth
  - Visualize data and environmental conditions
  - Real time data streams (currents, water levels, salinity etc.)
  - IHO standards and specifications (S-100 framework)

- The economic benefits of Precision Navigation will be
  - Increased margins of safety
  - Increased cargo capacity
  - Less delays in port
  - Decreased fuel usage
  - Increase port utilization

S-104
Water Levels

S-111
Surface Currents

S-412
Ocean Forecast

S-101
ENCs

S-102
Bathymetry

Value Added Resellers

Regulated Carriage

ENCRYPTED

S-100API

S-111CAT
S-102CAT
S-101CAT
Catalogue.xml
- Filepath
- Filename
- Date
- Discovery Metadata

S-100 Compliant metadata database

NOAA Navigaton Services

A little about Data Dissemination

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

KHOA