S-100 and S-101

The Past, Present and Future

What is S-100?

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

S-100

- Edition 1.0.0 approved in January 2010
- Edition 2.0.0
  - GML Profile
  - Portrayal Model
- Expected Approval: Mid 2015

Why Switch to S-100 ?

- Join mainstream GIS
  - maximizes access to COTS software and development
- New components not developed in isolation
- Easier use of hydro data beyond HOs and ECDIS users
  - coastal zone mapping, security, inundation modeling …
- Extensible and active feature catalogue registry
- *Plug-and-Play* updating of data, symbology and software enhancements

S-100 will support :

- Imagery and gridded data
- High-density bathymetry
- Seafloor classification
- 3-D and time-varying data (x,y,z and time)
- Dynamic ECDIS
- Supplementary layers - MIOs
- Marine GIS
- Web-based services
- other maritime data applications …

S-100 - Framework Data Structure for Hydrographic and Related Data

- Broad geospatial framework structure
  - Not specific to ECDIS or charting
  - Capable of accommodating other requirements
  - Increasing interest from prospective e-Navigation data providers
- Based on ISO 19100 series of geographic standards
- Multiple Encodings for different uses
  - ISO 8211, GML, XML

Additional Objectives

- Content and carrier are independent
- No need for new versions of product specifications or system revisions
  - *Plug-and-play* updating
- S-100 structure can easily accommodate present and future requirements
  - ECDIS
  - e-Navigation
  - Inland and Port ENC
  - Nautical Publications

Who is using S-100

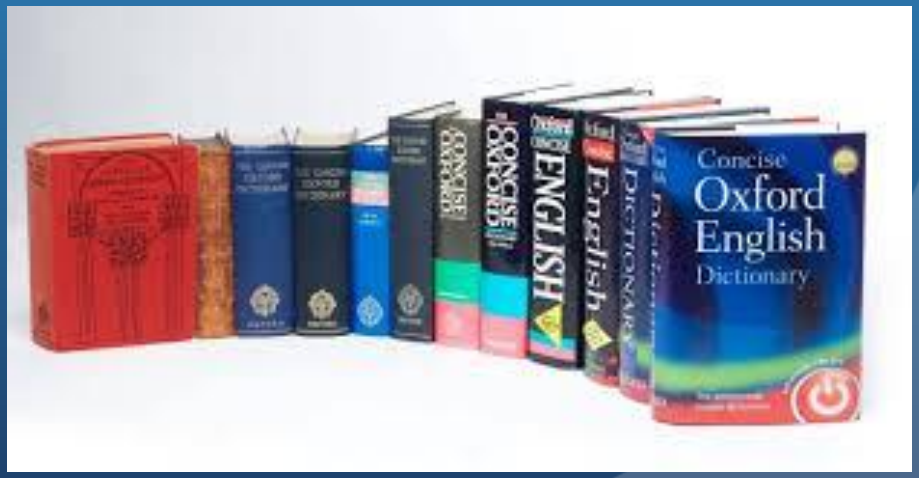
- International Hydrographic Organization
  - Electronic Navigational Charts
  - Nautical Publications
  - Surface Currents
  - Bathymetry
- IALA
  - AIS
  - VTS
  - ATONs
- WMO
  - Ice
  - Ocean Forecasts
- IMO
  - E-navigation

What is in S-100

- Contains Twelve Parts
  - Establishes the S-100 Registry/Register Mechanism
  - Provides Guidance on creating application Schemas
  - Metadata
  - Creating Feature Catalogues
  - Coordinate Reference Systems
  - Spatial Properties
  - Imagery and Gridded Data
  - Creating Portrayal Catalogues
  - Encoding Formats
  - Creating Product Specifications

IHO S-100 Registry and Registers

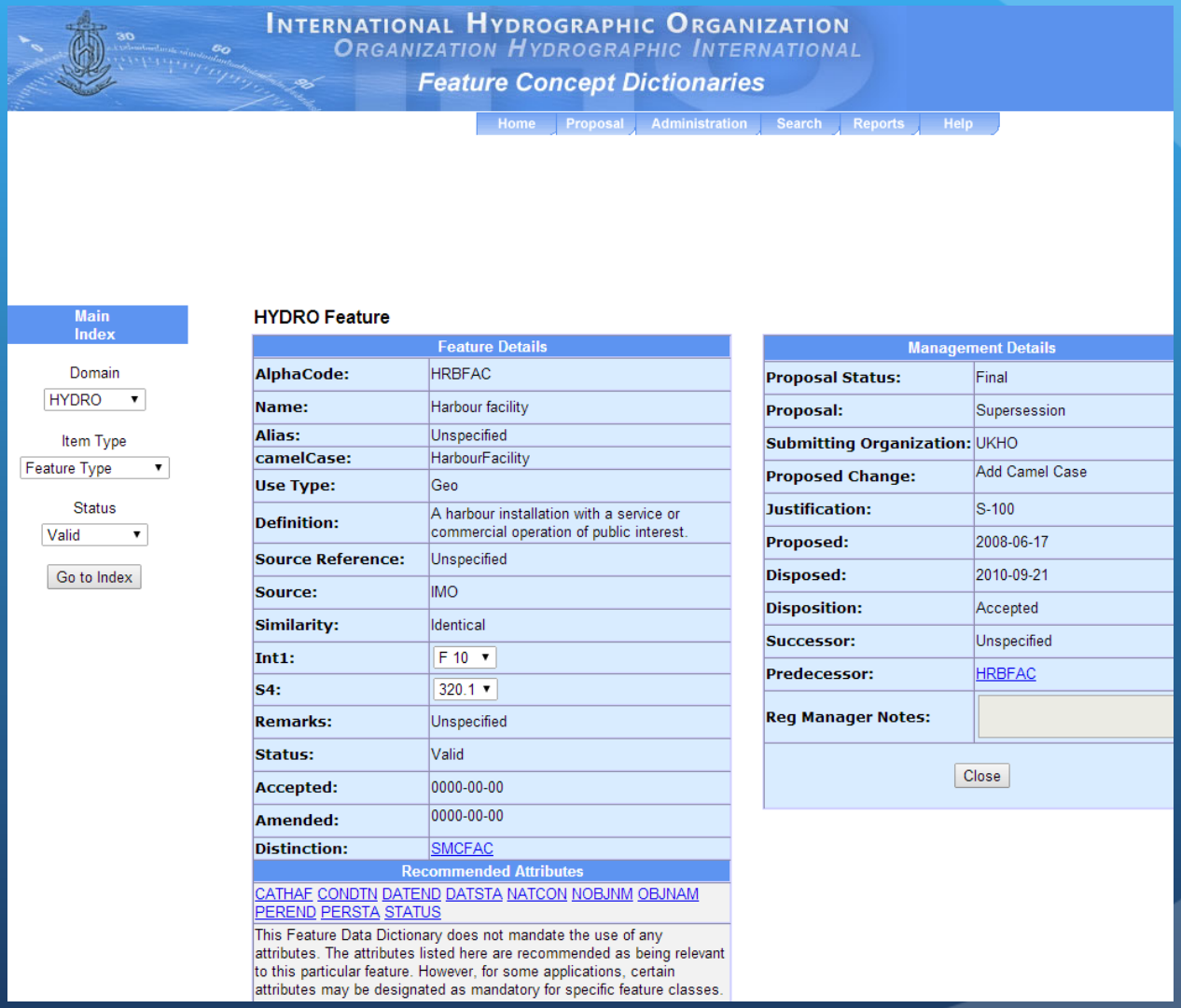
- A Registry is the entire information system in which a collection of registers is located
- A Register is a collection of tables containing identifiers assigned to items with descriptions
  - Names
  - Definitions
  - Usage Codes



S-100 Registers

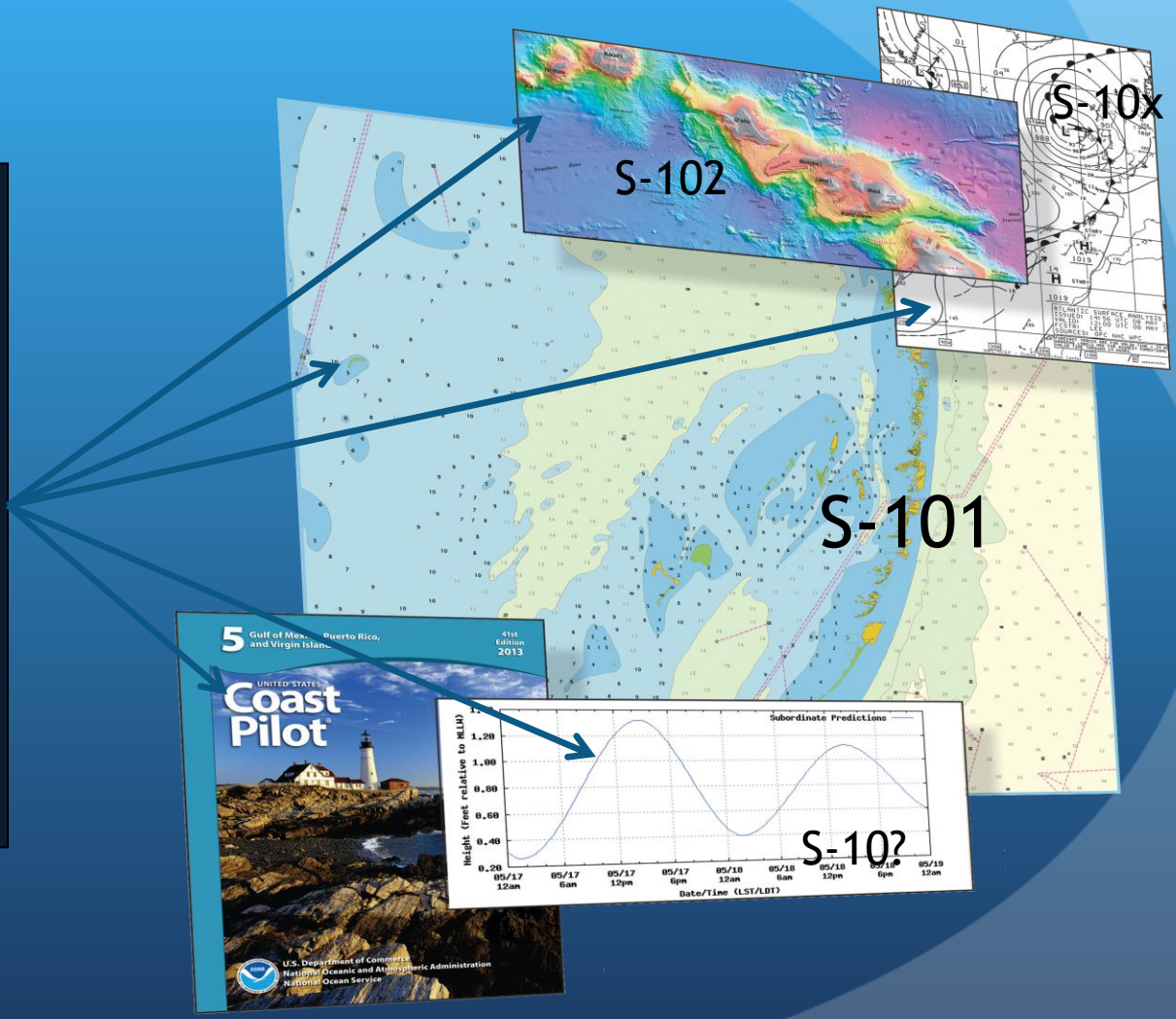
- Feature Concept Dictionary Registers
  - Hydro Domain
  - Nautical Publications
  - Ice
  - Inland ENC
  - Port ENC
  - AIS
  - ATONs
  - VTS
  - WXO - Weather
- Portrayal Registers
- Metadata Registers
- Data Producer Code register
- Product Specifications register

S-100 Register Content



S-100 and Product Specifications

… contains all the components to make different product specifications for all types of hydrographic data

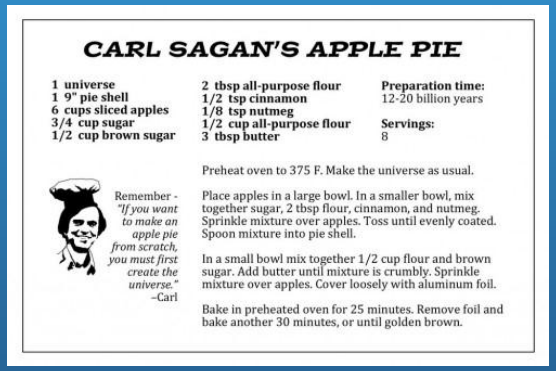


S-100 and Building Product Specifications

Ingredients

S-100

Recipe



CARL SAGAN'S APPLE PIE

1 universe
1 9" pie shell
6 cups sliced apples
3/4 cup sugar
1/2 cup brown sugar
2 tbsp all-purpose flour
1/2 tsp cinnamon
1/8 tsp nutmeg
1/2 cup all-purpose flour
3 tbsp butter

Preparation time: 12-20 billion years

Servings: 8

Preheat oven to 375 F. Make the universe as usual.

Remember - *"If you want to make an apple pie from scratch, you must first create the universe."* –Carl

Place apples in a large bowl. In a smaller bowl, mix together sugar, 2 tbsp flour, cinnamon, and nutmeg. Sprinkle mixture over apples. Toss until evenly coated. Spoon mixture into pie shell.

In a small bowl mix together 1/2 cup flour and brown sugar. Add butter until mixture is crumbly. Sprinkle mixture over apples. Cover loosely with aluminum foil.

Bake in preheated oven for 25 minutes. Remove foil and bake another 30 minutes, or until golden brown.

Product Specifications

Pie

Products

Part Number	Part Title	Description
1	Conceptual Schema Language	Defines the conceptual schema language and basic data types to be used with S-100
2 2a	Management of IHO Geospatial Information Registers Feature Concept Dictionary	Specifies how the IHO registry and registers will be managed and the Feature Concept Dictionary specifies definitions that may be used to describe geographic information and the use of registers to store them
3	General Feature Model and Rules for Application Schema	Introduces the rules for developing an application schema and the creation of the general feature model. The GFM is a conceptual model for features, their characteristics and associations
4	Metadata (General, Imagery and Gridded, Data Quality)	Specifies the metadata structure to be used in S-100
5	Feature Catalogue	Specifies the structure of the feature catalogue – which describes the content of a data product
6	Coordinate Reference Systems	Describes the spatial referencing by coordinates
7	Spatial Schema	Defines the information to describe and manipulate the spatial characteristics of features
8	Imagery and Gridded Data	Content model for gridded data for use in hydrographic applications
9	Portrayal	Specifies the portrayal model
10 10a	Encoding formats ISO/IEC 8211	Specifies the types of encoding formats in S-100
11	Product Specifications	Describes how to create an S-100 Product Specification
12	Maintenance Procedures	Specifies the maintenance procedures of S-100

User Requirements

- Need to determine what the users want
- Survey the users to determine the requirements
  - This will help focus on what is needed and what pieces of S-100 will be used (product requirements)
    - Hi Resolution Bathymetry
      - Gridded Format
    - Sailing Directions
      - GML and Vector
    - ENC
      - Vector

Building a Product Specification

- What is the Geometry Requirement
  - Vector or Coverage (Gridded)
    - This will help you determine which parts of S-100 you will need
- How will the data be primarily used
  - ECDIS, GIS
    - This will help you determine the encoding
      - 8211 – vector products that are intended for use on ECDIS
      - GML – Feature based products that are text heavy
      - Gridded – hi resolution bathymetry

Building a Product Specification (Vector)

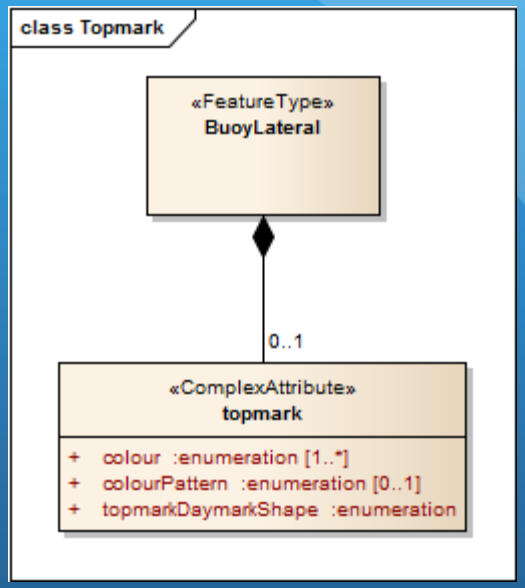
- Define your real world features and attributes
  - What is it that is being modeled?
  - If possible re-use existing features
- Determine how the features and attributes will be put together
  - What is a mandatory attribute
  - Is it a point, curve or surface

Data Classification and Encoding

IHO Definition: **FEATURE:** Definition. (Authority for definition).				
S-101 Geo Feature: Feature (S-57 Acronym) S-101 feature type, name and corresponding S-57 acronym				
Primitives: Point, Curve, Surface Allowable geometric primitive(s)				
Real World Example of real world instance(s) of the Feature.	*Paper Chart Symbol* Example(s) of paper chart equivalent symbology for the Feature.	*ECDIS Symbol* Example(s) of ECDIS symbology for the Feature.		
S-101 Attribute	**S-57 Acronym**	**Allowable Encoding Value**	**Type**	**Multiplicity**
Category of beer		1 : ale 2 : lager 3 : porter 4 : stout 5 : pilsener 6 : bock beer 7 : wheat beer	EN	1,1
This section lists the full list of allowable attributes for the S-101 feature. Attributes are listed in alphabetical order. Sub-attributes (Type prefix (S)) of complex (Type C) attributes are listed in alphabetical order and indented directly under the entry for the complex attribute (see below for example).	This section lists the corresponding S-57 attribute acronym. A blank cell indicates no corresponding S-57 acronym.	This section lists the allowable encoding values for S-101 (for enumerate (E) Type attributes only). Further information about the attribute is available in Section XX.	Attribute type (see clause X.X).	Multiplicity describes the "cardinality" of the attribute in regard to the feature. See clause X.X.
Fixed date range			C	0,1
Date end	(DATEND)		(S) DA	0,1
Date start	(DATSTA)		(S) DA	0,1

Building a Product Specifications

- New types of constructs
  - Complex Attributes
    - Topmark is an attribute made up of sub-attributes
      - Colour
      - Colour Pattern
      - Shape



Building a Product Specification

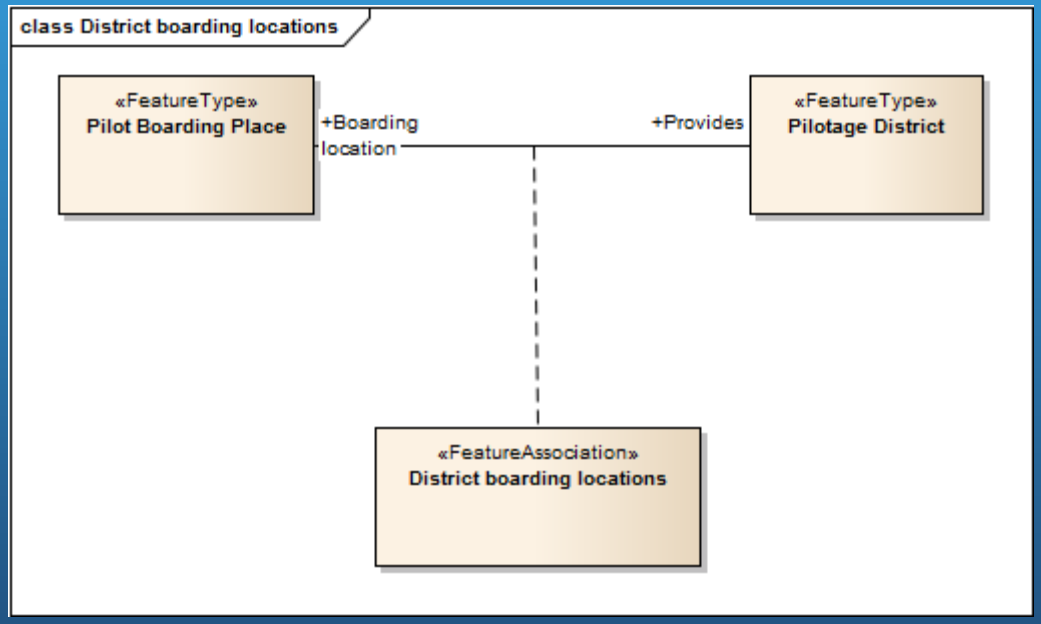
- Information Types
  - Can be shared with other features
  - Have attributes
  - Does not carry spatial information
- A chart note is an example of an information type
  - The same note can be associated with multiple features

Building a Product Specification

- Determine if you need to establish feature relationships
- S-100 Defines three types
  - Association
  - Aggregation
  - Composition
- Varying levels of strength

Associations

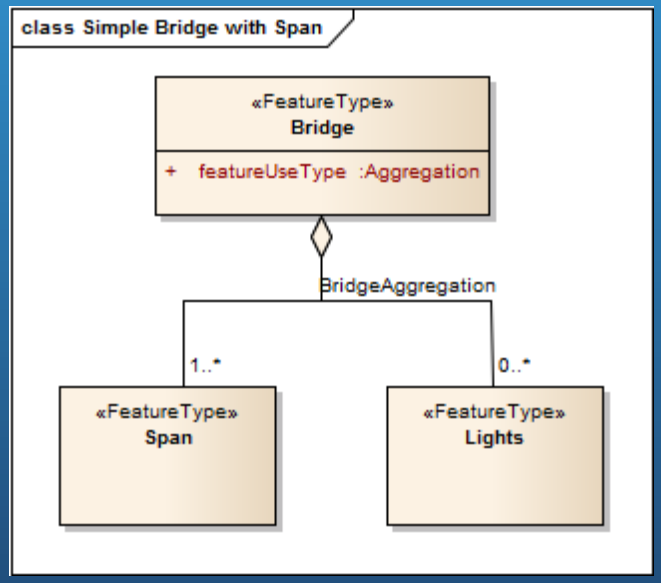
- Describes the relationship between two feature types



EXAMPLE : A **Pilot Boarding Place** feature provides a boarding location for a **Pilotage District** feature. An association named **District boarding locations** is used to relate the two features; roles are used to convey the meaning of the relationship

Aggregations

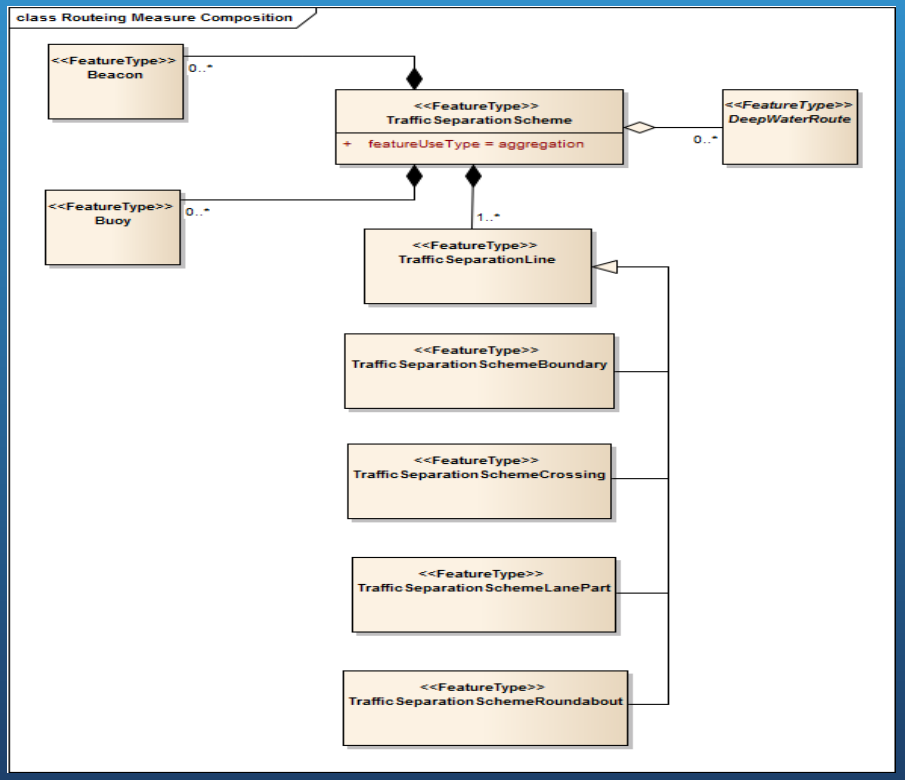
- A relationship between two or more feature types where the aggregation feature is made up of component features



EXAMPLE: **Bridge** feature of type aggregation may be composed of multiple **Span** features and may also include **Lights** and other features which make up the **Bridge**

Composition

- A strong aggregation, if a container feature is deleted then all of its containee features are deleted



EXAMPLE : If a feature type of TSS is deleted, then all of its component feature types that make up the TSS are deleted as they make up the **Routeing Measure** Composition.

Components of an S-100 Product Specification

Main

- Specifies what is need to build a complete product
  - Feature Types
  - Geometry
  - Data formats and file size
  - Metadata

Feature Catalogue

- Features
- Attributes
- Enumerants
- Bindings
- Point, Curve or Surface

Portrayal Catalogue

- Symbols, Line Styles and Area Fills
- Rule for how the feature attribute combination must be portrayed

Data Classification and Encoding Guide

- Contains the guidance for how the data should be encoded by the data producer
- Useful as a template for building the feature catalogue

Exchange Format

- Data format that is used for data exchange
  - ISO 8211 – normally used for ECDIS
  - GML – good for exchanging information outside of the ECDIS arena
  - XML – text based data exchange for both ECDIS and non - ECDIS

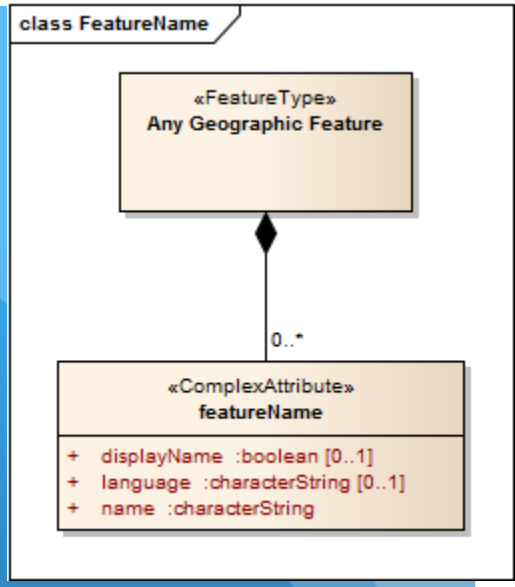
Building a Product Specification

- Register any new features/attributes/enumerations
- Create an XML Feature Catalogue
  - IHO is establishing a feature catalogue builder that links to the IHO registry
- Determine if you need new portrayal
- Create an XML Portrayal Catalogue
  - IHO is establishing a portrayal catalogue builder
- Create Test Data
  - Enlist the assistance of expert contributors
- Organize a test bed

S-101

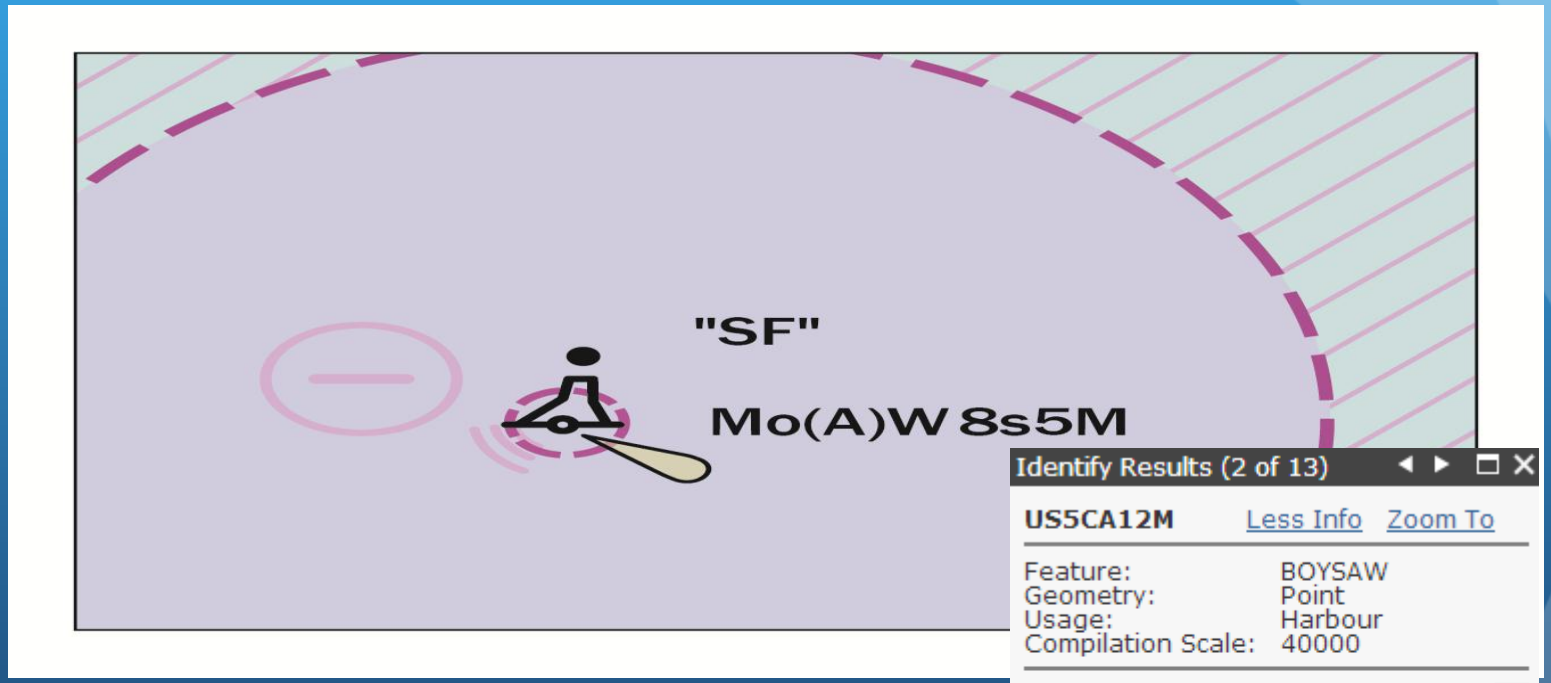
- S-101 represents a major step forward in product specifications for Electronic Navigational Charts
- Based on S-100 – the Universal Hydrographic Data Model
- Will eventually replace S-57 (in the future)
  - Utilize a convertor from S-57 to S-10 to allow HO's time to upgrade their production systems

S-101 Complex Attributes

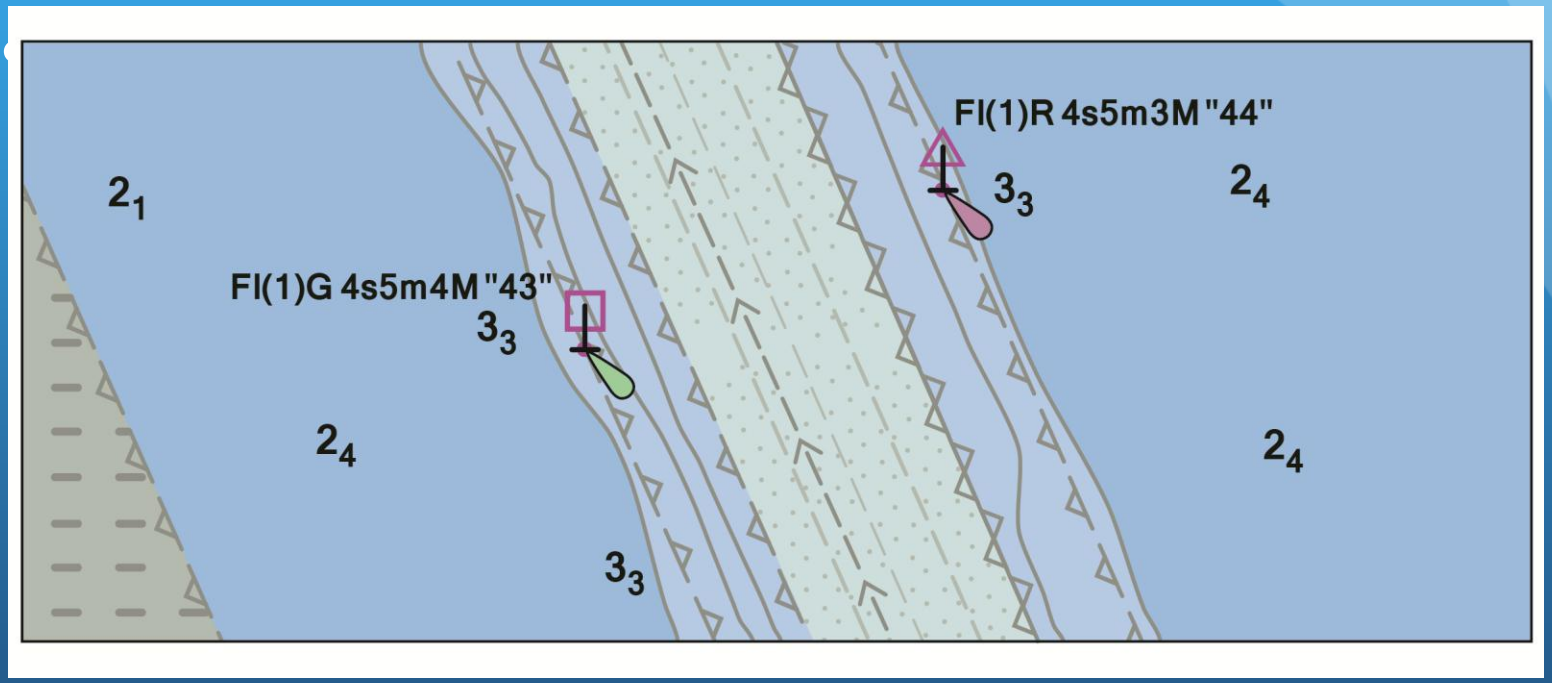


- Improved Modelling
- Introduces the concept of sub attributes
- S-57 modelled proper names using OBJNAM
- S-101 introduces the complex “Feature Name”
  - Display Name
  - Language
  - Name
- Allows for multiple languages and encoding of a “short name”

S-101 Display Name

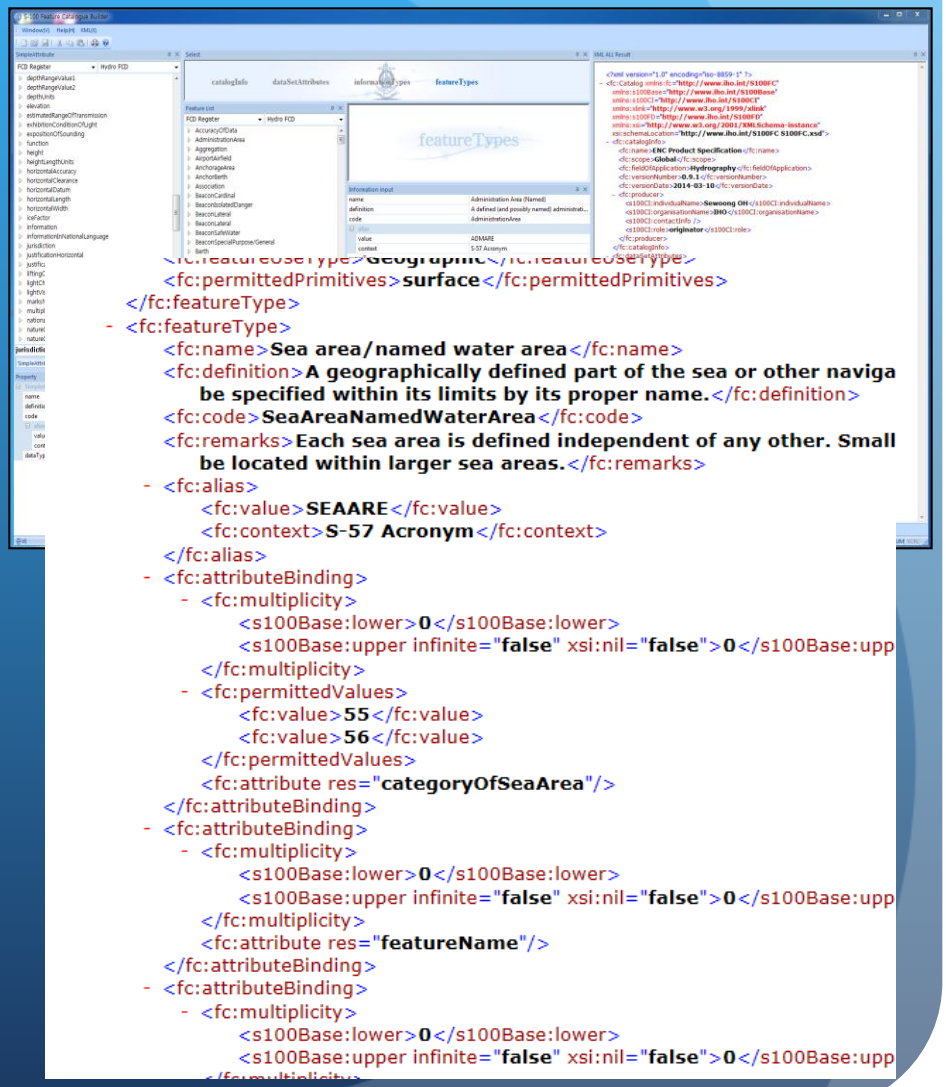


S-101 Text Placement



S-101 Machine Readable Catalogues

- Feature Catalogues
  - XML format
  - Binds features, attributes and enumerants together
  - Assigns Point, Curve or Surface to each feature
  - Establishes Feature associations

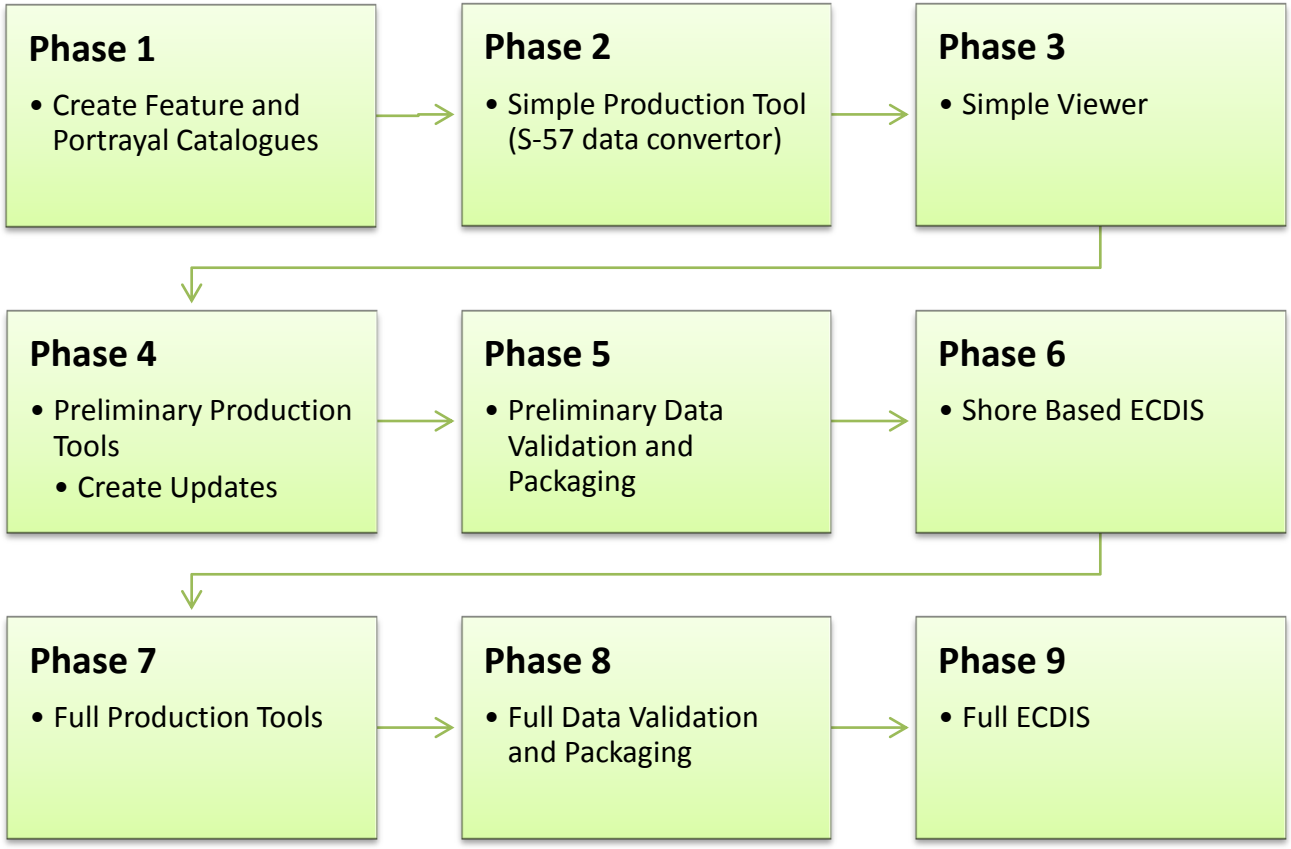


S-101 Machine Readable Portrayal Catalogues

- XML format
- Conditional Symbology Procedures are converted to XSLT
- Creates and edits portrayal rules for features/attributes/enumerants that have been defined in the feature catalogue
- Assigns symbols to each of the rules
  - SVG – Scalable Vector Graphics

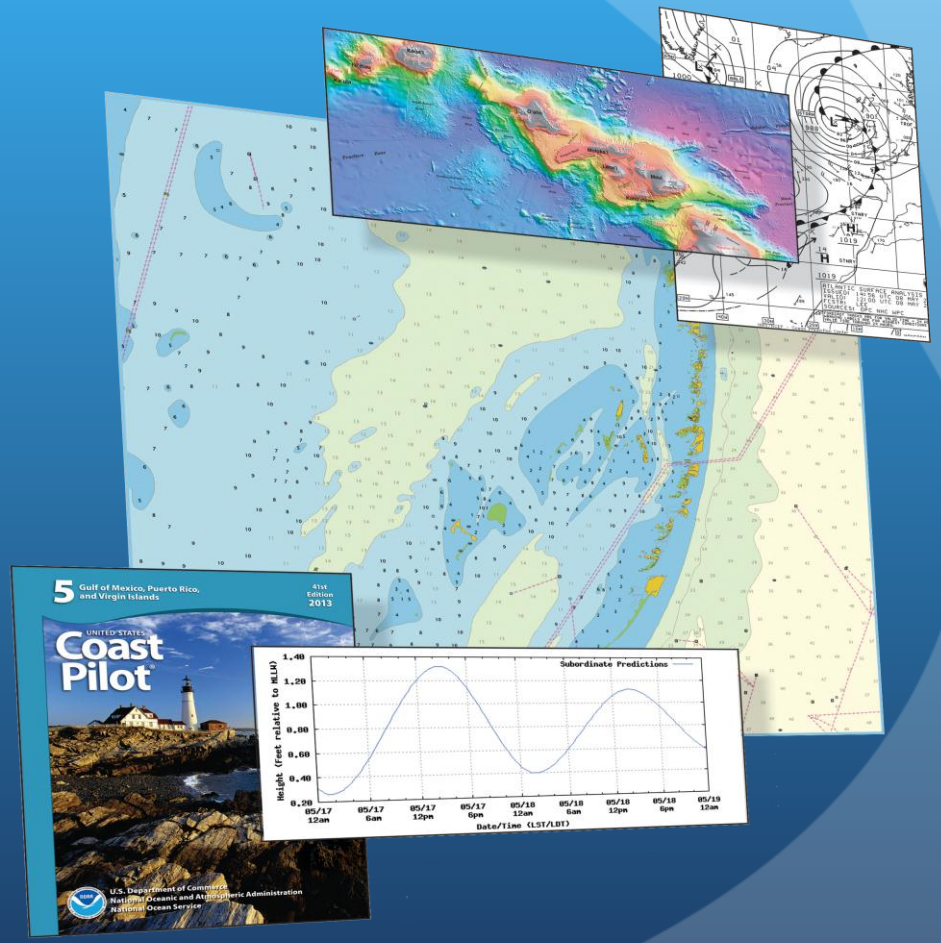
S-100/S-101 Test bed

- IHO is establishing an S-100 test bed
  - Test the functionality of S-100 Product Specifications
- Phased approach
  - Multiple sub-systems
  - Iterative Development
  - Nine Distinct Phases


Phase 1
• Create Feature and Portrayal Catalogues
Phase 2
• Simple Production Tool (S-57 data convertor)
Phase 3
• Simple Viewer
Phase 4
• Preliminary Production Tools
• Create Updates
Phase 5
• Preliminary Data Validation and Packaging
Phase 6
• Shore Based ECDIS
Phase 7
• Full Production Tools
Phase 8
• Full Data Validation and Packaging
Phase 9
• Full ECDIS

Beyond S-100

- Multiple Product Specifications are in the works
  - Coast Pilot Information
  - Marine Protected Areas
  - Ocean Forecast
  - Tides
  - Surface Currents



What does this all mean?

- Improved Standardization between hydrographic products
- Improved data interoperability
- Data is not just for Shipboard Navigation