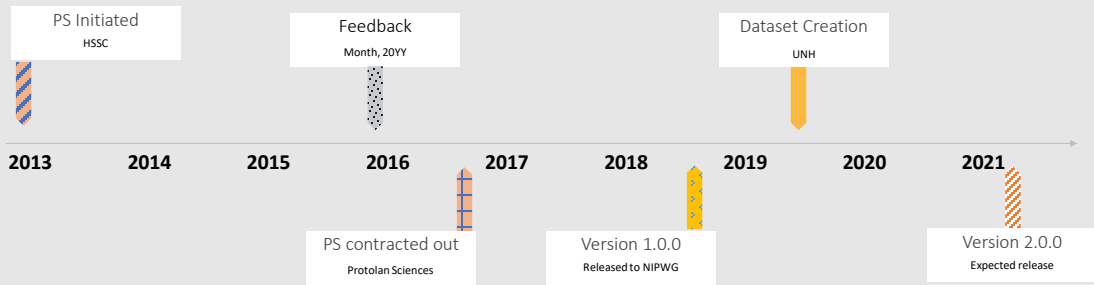# Pilotage
*A Prototype for data storage and creation*

S-127 Traffic Services

briana sullivan - UNH

NOTE: I only focused on the Pilot Services portion of this product instead of the entire Traffic Services Schema!

S-127 Development Timeline

| PS Initiated | Feedback | Dataset Creation |
| HSSC | Month, 20YY | UNH |

2013   **2014**   **2015**   **2016**   **2017**   **2018**   **2019**   **2020**   **2021**

| PS contracted out | Version 1.0.0 | Version 2.0.0 |
| Protolan Sciences | Released to NIPWG | Expected release |

The release of the S-127 Traffic Management product specification this year provided for a great opportunity to test how the Coast Pilot could automatically generate the product as well as do some testing for the NIPWG group.
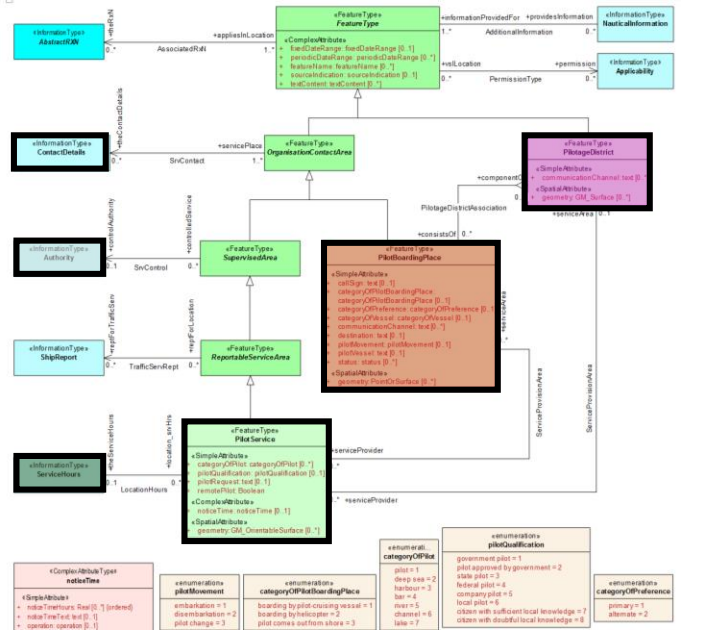
Manual Generation

Of the GML S-127 product
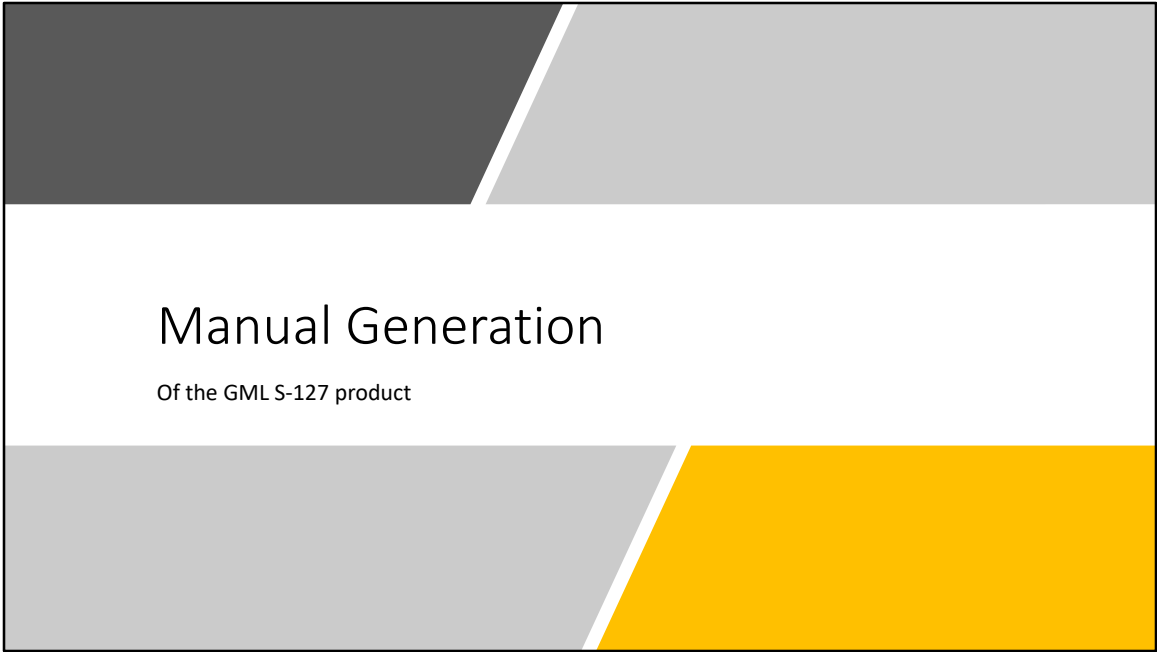
The first step was just to manually create the GML product.

Study UML
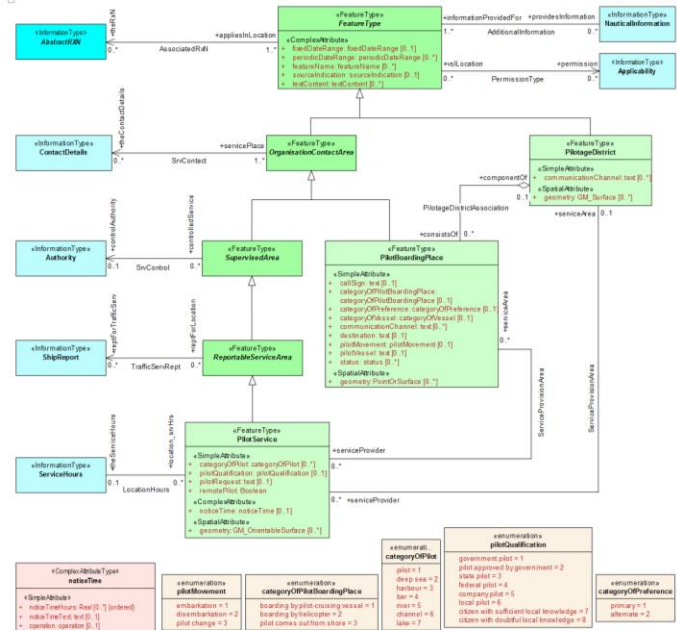
Using the S-127 Pilot Services schema, I was able to identify and list the primary elements that would be used and their relationships.

The primary elements (6 highlighted here) were the guide for working with the text….

Feature types (with lat/lng polygons):
1. PilotDistrict (PINK)
2. PilotBoardingPlace (RED)
3. PilotService (GREEN)

Information types:
1. ContactDetails (LIGHT BLUE)
2. Authority (GREY)
3. ServiceHours (OLIVE)

Identify CP text

Items in Data structure

Color key

ContactDetails	PilotDistrict
Authority	PilotService
Applicability/permissionType	PilotBoardingPlace
	ServiceHours

chapter 3

(221) Pilotage, general

(222) Pilotage is compulsory for all foreign vessels and U.S. vessels under register in the foreign trade. Pilotage is optional for coastwise vessels that have on board a pilot properly licensed by the Federal Government for the waters which the vessel travels.

(223) The Maryland Pilots maintain a pilot station at Cape Henry; Virginia State pilots maintain a pilot station at Cape Henry; pilots for Delaware Bay and River maintain a pilot station at Cape Henlopen; Maryland State pilots and pilots for Delaware Bay and River also maintain a joint pilot station at Chesapeake City, MD, on the Chesapeake and Delaware Canal.

(224) The Chesapeake and Interstate Pilots Association offers pilotage to U.S. vessels engaged in the coastwise trade. Pilotage is also available to public vessels. The association serves vessels transiting Chesapeake Bay and its tributaries, Chesapeake and Delaware Canal, and Delaware Bay and River. Chesapeake and Interstate Pilots Association has an office in Norfolk (telephone, 757-855-2733).

(225) The Interport Pilots Agency, Inc., offers pilotage to public vessels and private vessels in the coastal trade transiting the Delaware Bay and River, Chesapeake and Delaware Canal, Upper Chesapeake Bay, New York Harbor, Long Island Sound and other areas along the northeast coast. Arrangements for their services are made 24 hours in advance through the ship's agents or by contacting Interport Pilots Agency, Inc., 906 Port Monmouth Road, Port Monmouth, NJ 07758-0236, telephone 732-787-5554 (24

(63) The Pilots' Association for the Bay and River Delaware maintains its office in Philadelphia, PA, a pilot station in Lewes, DE, and a pilot watch tower on Cape Henlopen. The office address is 800 South Columbus Blvd., Philadelphia, PA 19147; telephone, 215–465–8340; fax, 215–465–3970; cable, DELPILOTS in Philadelphia; and email address: dispatch@delpilots.com. The pilot station address is 41 Cape Henlopen Drive, Lewes, DE 19958; telephone, 302–645–2228; fax, 302–645–7822. The pilot watch tower at Cape Henlopen's telephone number is 302–645–8538; fax, 302–645–1728. Pilots are generally arranged for in advance through ships' agents and board incoming vessels from the pilot boat in the pilot boarding area off Cape Henlopen. Vessels are requested to contact pilots when inbound at either Delaware Lighted Buoy D or Five Fathom Bank Lighted Buoy F; both buoys are equipped with a racon. Vessels not requiring pilots are requested to contact "Cape Henlopen Tower" one hour prior to entering or departing Delaware Bay.

(64) The pilot boats are 50 feet long with black hulls and white houses with the word "PILOT" in large letters on each side. The pilot station and pilot boats may be contacted on VHF-FM channels 14 and 16. The pilots carry portable radiotelephones for bridge-to-bridge communications on VHF-FM channel 13.

(65) The Pilots' Association for the Bay and River Delaware also provides qualified offshore "advisors" for the deepest draft vessels between Lighted Buoy "D" and the anchorage areas in Delaware Bay. A notice of 24 hours before estimated arrival is requested for this service

(66) The Chesapeake and Interstate Pilots Association offers pilot services to U.S. vessels engaged in the coastwise trade and to public vessels between Cape Henlopen, Philadelphia and Delair. Arrangements for pilots are made through ships' agents or the pilot office in Norfolk (telephone, 757–855–2733). Pilots use commercial launch services and will meet vessels in the Pilotage Area off Cape Henlopen. Pilots arrive at the launch one hour prior to arrival and monitor VHF-FM channel 16 one hour prior to last ETA. Cellular telephone confirmation with the pilot office in Norfolk or the launch service can be made at 302–422–7604 if radio contact is unsuccessful. Advance pilot ordering with a 6-hour ETA update and any subsequent changes is requested.

(67) The Interport Pilots Agency, Inc. offers pilotage to public vessels and private vessels in the coastal trade transiting the Delaware Bay and River, Chesapeake and Delaware Canal, Upper Chesapeake Bay, New York Harbor, Long Island Sound and other areas along the northeast coast. Arrangements for their services are made 24 hours in advance through the ship's agents or by contacting Interport Pilots Agency, Inc., 906 Port Monmouth Road, Port Monmouth, NJ 17758–0236, telephone 732–787–5554 (24 hours), or by e-mail at interport@verizon.net. Additional information about Interport Pilots can be

looking over the Coast Pilot text sections with the header PILOTAGE I could then take the primary elements within the S-127 Pilot Services that would apply.

Once the initial concepts were highlighted with the matching UML color it became easier to see the patterns and find the elements throughout the document.

When the primary elements were all found, what was left was either creatively forced to fit the best candidate element or was kept as a comment to possibly improve the representation of the S-127 schema.

NOTE: I collated all the information from the entire chapter 3, that is why the paragraph numbers are not in sequence.
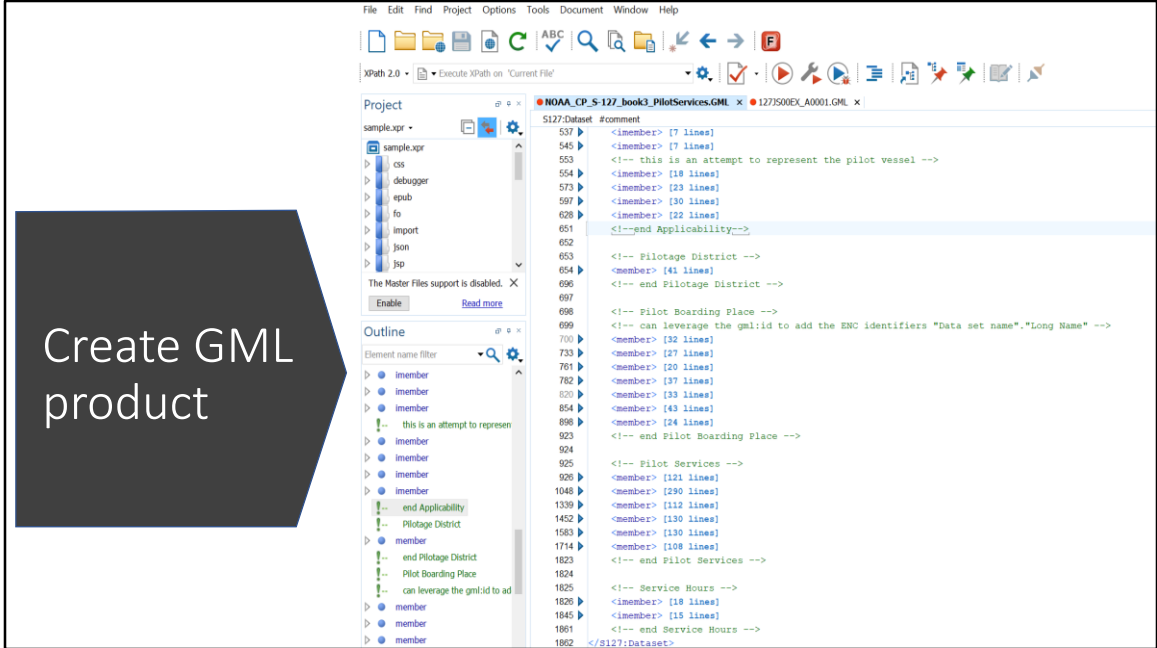
Create GML product

A GML (this is simply geo-referenced XML) product was then created from the text that was marked up and checked for correctness against the standard….

External Verification of created product
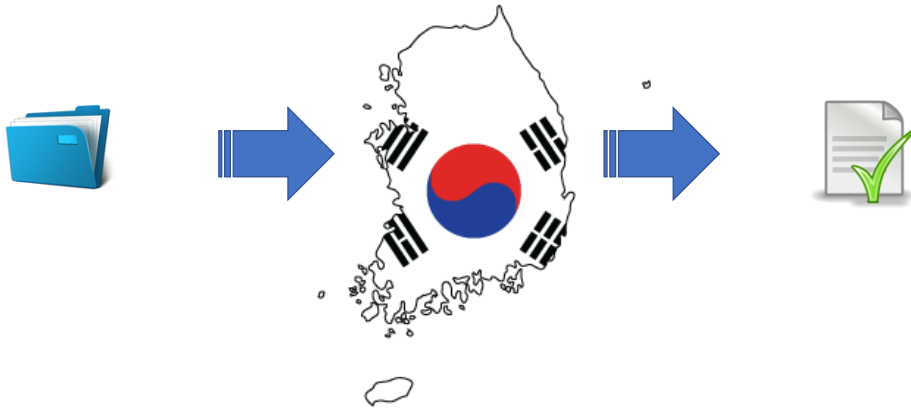
After the GML document was created and validated it was sent to the Republic of Korea for external verification.

Once given the green light from the ROK, it was ready to implement within the nautical textual information database system

Automated Generation

Of the GML S-127 product

With the GML version okayed I had more confidence moving forward to invest more time into an automated system that would store and generate the S-127 data.
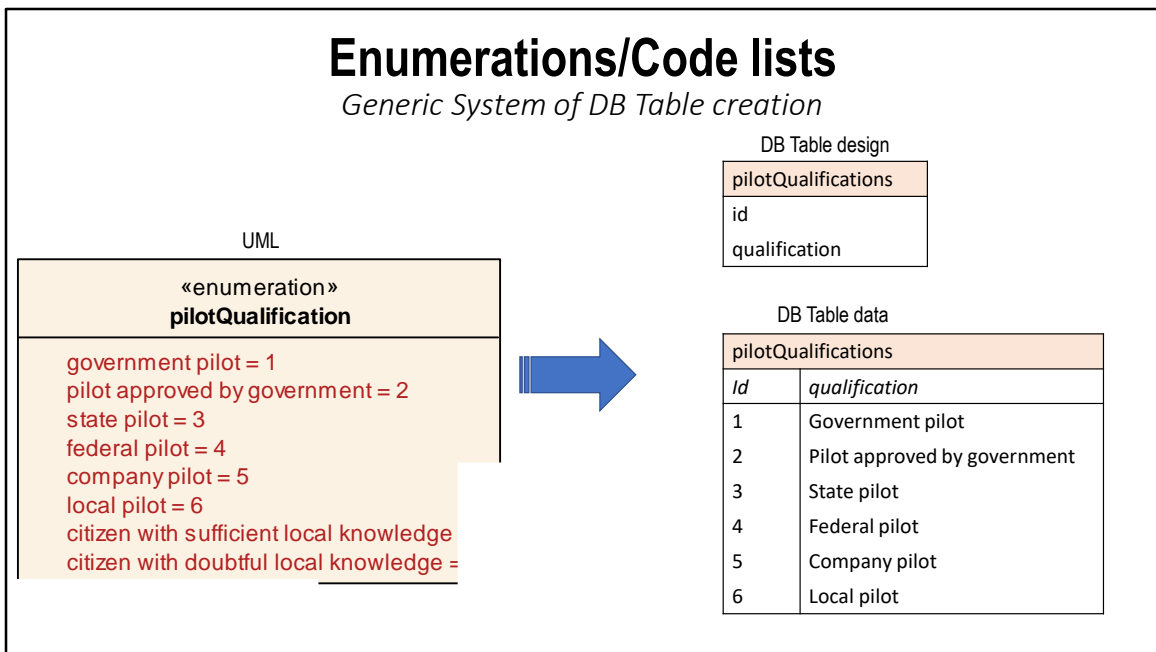
This prototype was also a proof-of-concept in how to take any existing S-100 nautical textual data from NIPWG products and create a generic way to set up a relational database that would accurately reflect the model.

Create Database Schema

GML to DB tables
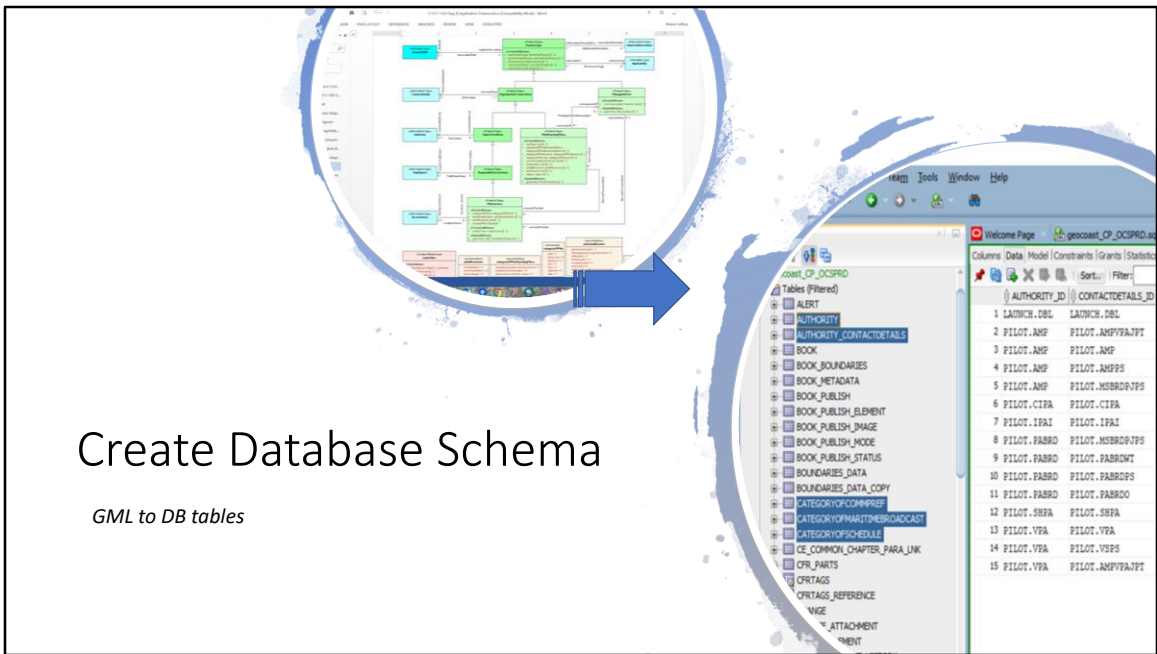
From the S-127 schema we then build up the database to match the UML/Application Schema, in an iterative process, to see how things work once relationships are established.

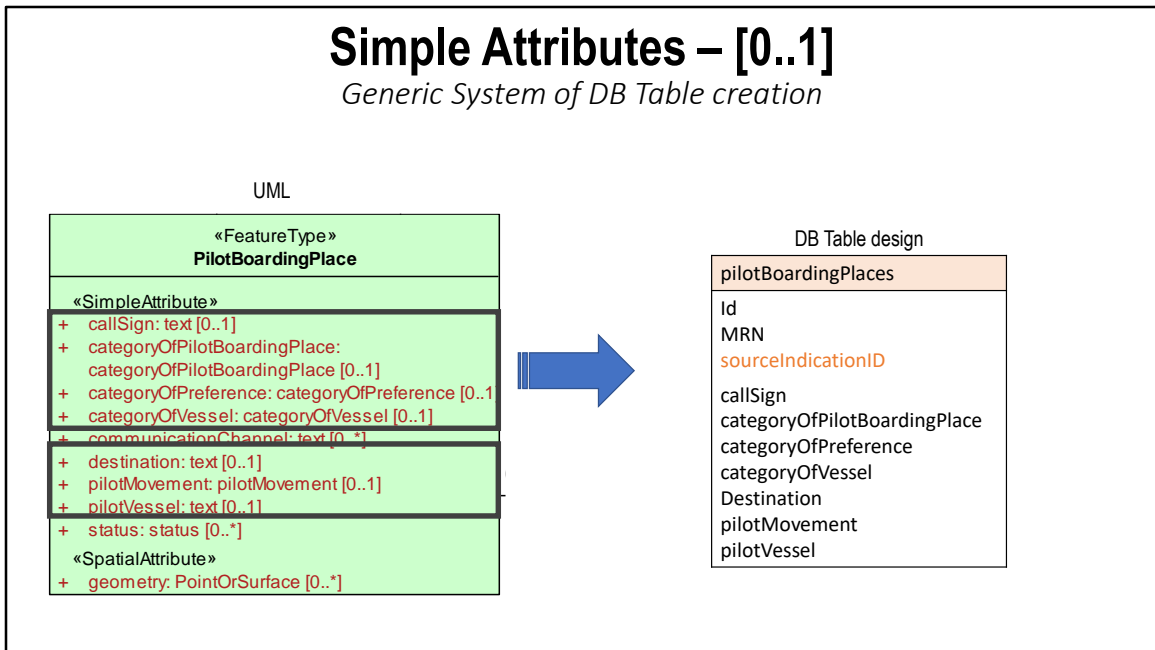# Enumerations/Code lists
Generic System of DB Table creation

DB Table design

pilotQualifications
id
qualification

UML

«enumeration» **pilotQualification**
government pilot = 1 pilot approved by government = 2 state pilot = 3 federal pilot = 4 company pilot = 5 local pilot = 6 citizen with sufficient local knowledge citizen with doubtful local knowledge =

DB Table data

pilotQualifications	
Id	*qualification*
1	Government pilot
2	Pilot approved by government
3	State pilot
4	Federal pilot
5	Company pilot
6	Local pilot

these can be easily stored in a database table and used in an interface to fill in attributes of the associated tables. (Helping to avoid spelling errors, ensuring normalization on terms)

And remember…once it has been created and filled in…it is DONE and available for reuse in any other product!

It it most helpful to create tables for enumerations if the spec allows for "other", that would mean this list could grow…and better to keep track of the used items to ensure a refinement of terms used!

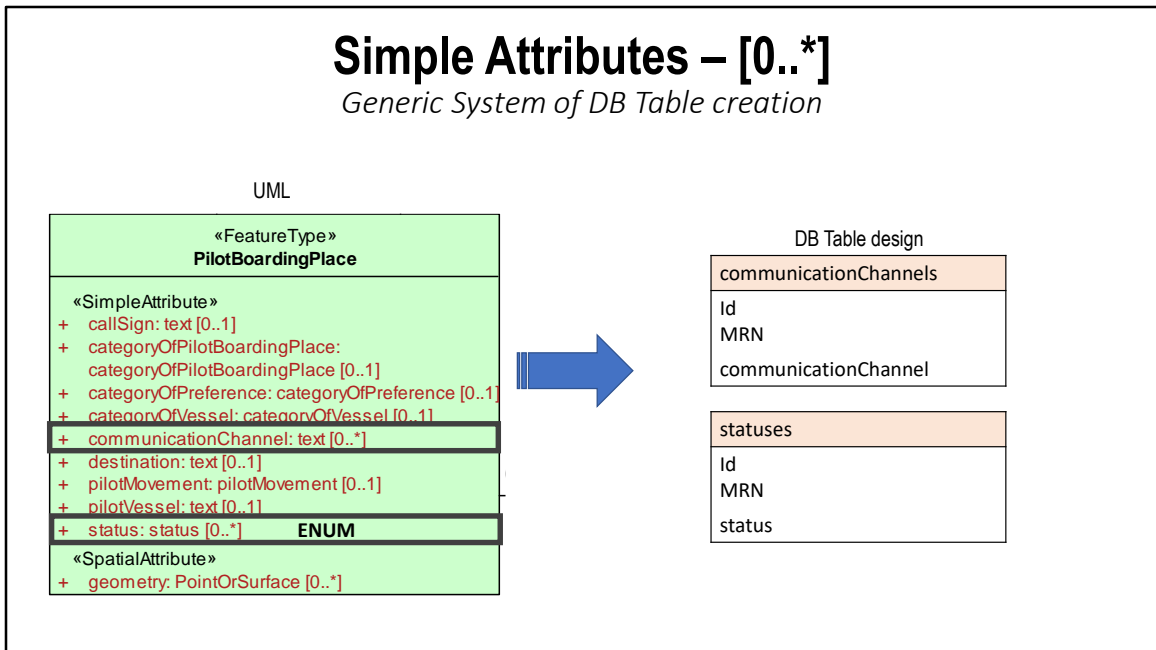# Simple Attributes – [0..1]
Generic System of DB Table creation

UML

«FeatureType» **PilotBoardingPlace**
«SimpleAttribute»
+   callSign: text [0..1]
+   categoryOfPilotBoardingPlace: categoryOfPilotBoardingPlace [0..1]
+   categoryOfPreference: categoryOfPreference [0..1]
+   categoryOfVessel: categoryOfVessel [0..1]
+   communicationChannel: text [0..*]
+   destination: text [0..1]
+   pilotMovement: pilotMovement [0..1]
+   pilotVessel: text [0..1]
+   status: status [0..*]
«SpatialAttribute»
+   geometry: PointOrSurface [0..*]

DB Table design

pilotBoardingPlaces
Id
MRN
sourceIndicationID
callSign
categoryOfPilotBoardingPlace
categoryOfPreference
categoryOfVessel
Destination
pilotMovement
pilotVessel

Singles - these become elements of a main feature or complex type table as long as the multiplicity is [0..1].

Notice the sourceIndication is an *inherited* attribute from the superclass FeatureType, since it is the only attribute that has a multiplicity of [0..1] it is included all the main tables for the specific feature type. HOWEVER, because it is a complex attribute it will have an id to the table that will represent the other subattributes that make up this attribute.

See complex attributes later in the presentation for more.

Simple Attributes – [0..*]
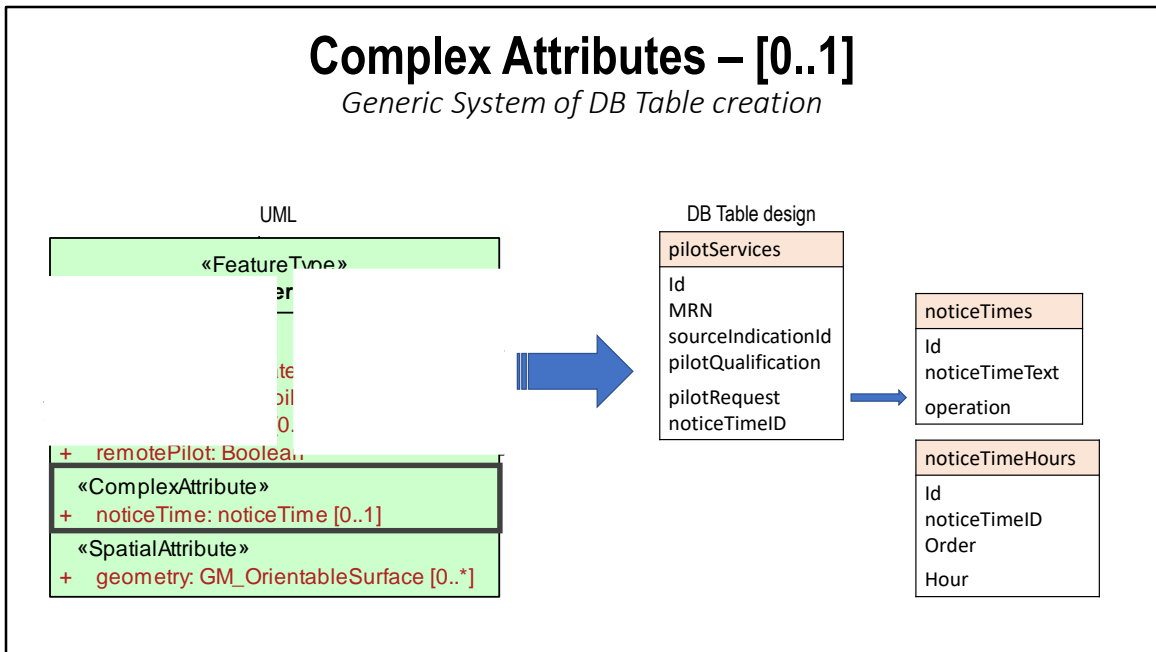*Generic System of DB Table creation*

UML

«FeatureType» **PilotBoardingPlace**
«SimpleAttribute»
+ callSign: text [0..1]
+ categoryOfPilotBoardingPlace: categoryOfPilotBoardingPlace [0..1]
+ categoryOfPreference: categoryOfPreference [0..1]
+ categoryOfVessel: categoryOfVessel [0..1]
+ communicationChannel: text [0..*]
+ destination: text [0..1]
+ pilotMovement: pilotMovement [0..1]
+ pilotVessel: text [0..1]
+ status: status [0..*]   ENUM
«SpatialAttribute»
+ geometry: PointOrSurface [0..*]

DB Table design

communicationChannels
Id
MRN
communicationChannel

statuses
Id
MRN
status

Multiples - When the multiplicity includes [0..*] then a new one-to-many or many-to-many table needs to be created that can link the infinite list to its owner table.

NOTE: as a database best practices naming conventions for tables is in the plural
Also, the link from PilotBoardingPlace to communicationChannel is considered one-to-many because each pilot boarding place can have many communication channels associated with it. (Same goes for status).
They are linked from the PilotBoardingPlace.MRN to communicationChannels.MRN attributes and the PilotBoardingPlace.MRN to statuses.MRN.

Complex Attributes – [0..1]
Generic System of DB Table creation

UML

DB Table design

«FeatureType»
~~er~~

te
il
0.
+   remotePilot: Boolean

«ComplexAttribute»
+   noticeTime: noticeTime [0..1]

«SpatialAttribute»
+   geometry: GM_OrientableSurface [0..*]

pilotServices

Id
MRN
sourceIndicationId
pilotQualification

pilotRequest
noticeTimeID

noticeTimes

Id
noticeTimeText

operation

noticeTimeHours

Id
noticeTimeID
Order

Hour

Single complex attributes only need an id to the table{s} containing all the information for that attribute.
Using the single ID as reference to all associated tables all info for that id will be able to be recalled.

(NOTE: the link from the pilotServices table to the noticeTimes table is called a one to one relationship as there will be only be one id that matches exactly. However, the noticeTimeHours table will be able to repeat the id since there is a multiplicity of [0..*] so the relationship between noticeTimes and noticeTimeHours is one-to-many: one noticeTime id to many noticeTimeHours.

Complex Attributes – [0..*]
Generic System of DB Table creation

UML

| «FeatureType» |
| *FeatureType* |

«ComplexAttribute»
+ fixedDateRange: fixedDateRange [0..1]
+ periodicDateRange: periodicDateRange [0..*]
+ featureName: featureName [0..*]
+ sourceIndication: sourceIndication [0..1]
+ textContent: textContent [0..*]

DB Table design

| pilotServices |
| Id |
| MRN |
| sourceIndicationId |
| pilotQualification |
| pilotRequest |
| noticeTimeID |

| featureNames |
| Id |
| MRN |
| displayName |
| language |
| name |

Multiple complex attributes will be linked by MRN/id and be set up just like the other tables were described depending on the attribute type and multiplicity. (In computer science terms…it's recursive)

NOTE: Again, the linking of the tables from pilotServices to featureNames is via the MRN. Also note…keeping all the feature names in the same table will help to eliminate accidental duplicates (aka "normalizing the database") as well as help to collate a dictonary of names all in one place. This is true for normalizing the database by setting up tables to isolate the specific types of data. Although it may initially appear complex…it all really boils down to the simplest elements and the patterns just repeat and build upon each other.

Feature Types
Generic System of DB Table creation

UML

«FeatureType» ***FeatureType***
«ComplexAttribute»
+ fixedDateRange: fixedDateRange [0..1]
+ periodicDateRange: periodicDateRange [0..*]
+ featureName: featureName [0..*]
+ sourceIndication: sourceIndication [0..1]
+ textContent: textContent [0..*]

DB Table design

pilotServices
Id
MRN
sourceIndicationId
pilotQualification
pilotRequest
noticeTimeID

featureNames
Id
MRN
displayName
language
name

Multiple complex attributes will be linked by MRN/id and be set up just like the other tables were described depending on the attribute type and multiplicity. (In computer science terms…it's recursive)

NOTE: Again, the linking of the tables from pilotServices to featureNames is via the MRN. Also note…keeping all the feature names in the same table will help to eliminate accidental duplicates (aka "normalizing the database") as well as help to collate a dictonary of names all in one place. This is true for normalizing the database by setting up tables to isolate the specific types of data. Although it may initially appear complex…it all really boils down to the simplest elements and the patterns just repeat and build upon each other.

MRN style Identifiers

Items	Name	MRN example
Pilotage District	Chesapeake Bay	USA.PILDST.CB
Authority	Delaware Bay Launch	CB.AUTORI.LAUNCH.DBL
Contact Details	Delaware Bay Launch	CB.CONDET.LAUNCH.DBL
Permissions	Required for foreign vessel	CB.PERM.required.foreign
Applicability	All foreign vessels	CB.APPLIC.foreign
Pilot Boarding Place	Cape Henry Pilot boarding	CB.PILBOP.US3EC08M.US000063059964398
Pilot Service	The Chesapeake and Interstate Pilots Association	CB.PLTSRV.CIPA
Service Hours	24-7 (normal operation)	SRVHRS.NORMOP.247

The basic pattern waterway initials, item acronym, type name, feature name initials.

So, for example, the Authority the Delaware Bay Launch would have the following identifier assigned: CB.AUTORI.LAUNCH.DBL (CB – Chesapeake Bay, AUTORI – Authority, LAUNCH – launch, DBL – Delaware Bay Launch).

This is an attempt to follow the IHO recommended MRN (Maritime Resource Name) format for unique and PERSISTENT identifiers. (I also have attempted to make it backwards compatible by continuing to reference ENC FOIDs until a later time.)

It is only a recommendation for within the IHO domain…however each HO will need to produce their own formula for generating these names.

NOTE: These ids followed the recommendation in the example S-127 file that was distributed with the product spec. (And a worthy topic of discussion if anyone is interested later…. come see me!).

MRN as primary key id

Note the ID's in the database table. Utilizing the MRN identifiers to be the link between tables within the DB.

This is very important to establish soon so interoperability between these new S-100 products will exist. And so the identifiers become PERSISTANT and UNIQUE!

The other benefit to setting up the database in this manner is the evolution of roles in data management from manager of a book or area to the possibility of data specialists who manage sets of a specific data.

Use Python
to create GML

Once the database is set up it can be populated with the highlighted data from the text.

We are then able to use python to access the stored data and auto generate the GML S-127 Pilot Services product.

And we return full circle back to where we began…

I am NOT there YET….this is still a work in progress that I am hoping to complete by the end of the year.

Formats could include (but not be limited to) the textual paragraphs in the Coast Pilot book (for backward compatibility)

Displaying the data
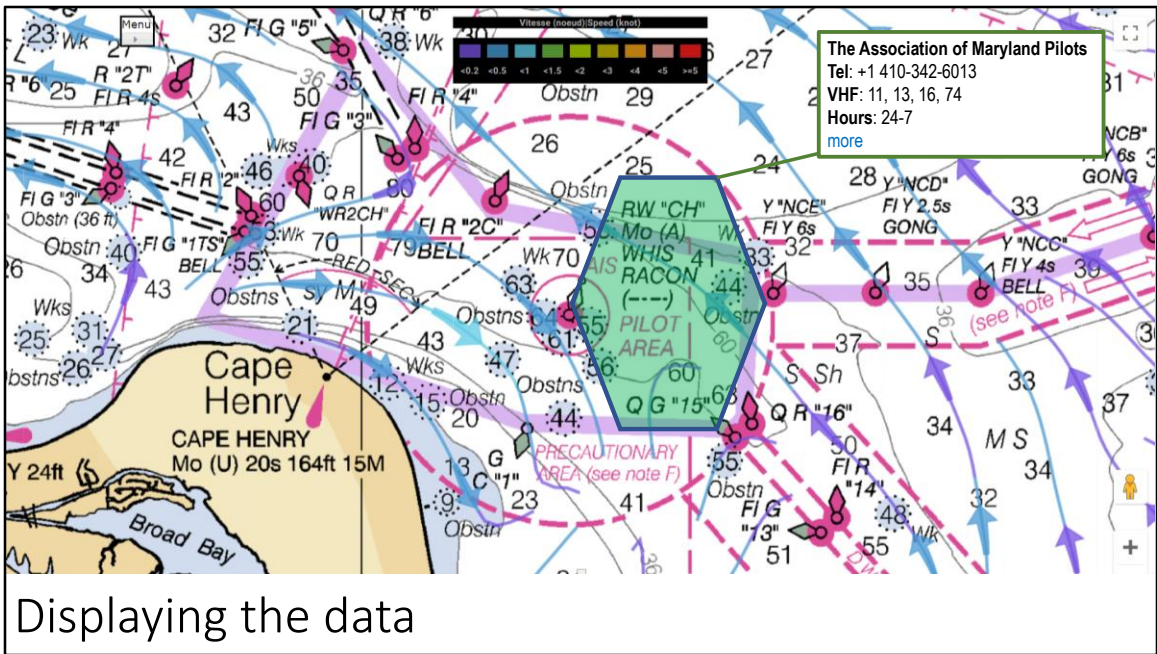
…as well as ways to reuse, collate, filter and separate the data depending on desired use.

The ultimate goal in the chart of the future!

Issues found

during S-127 creation process
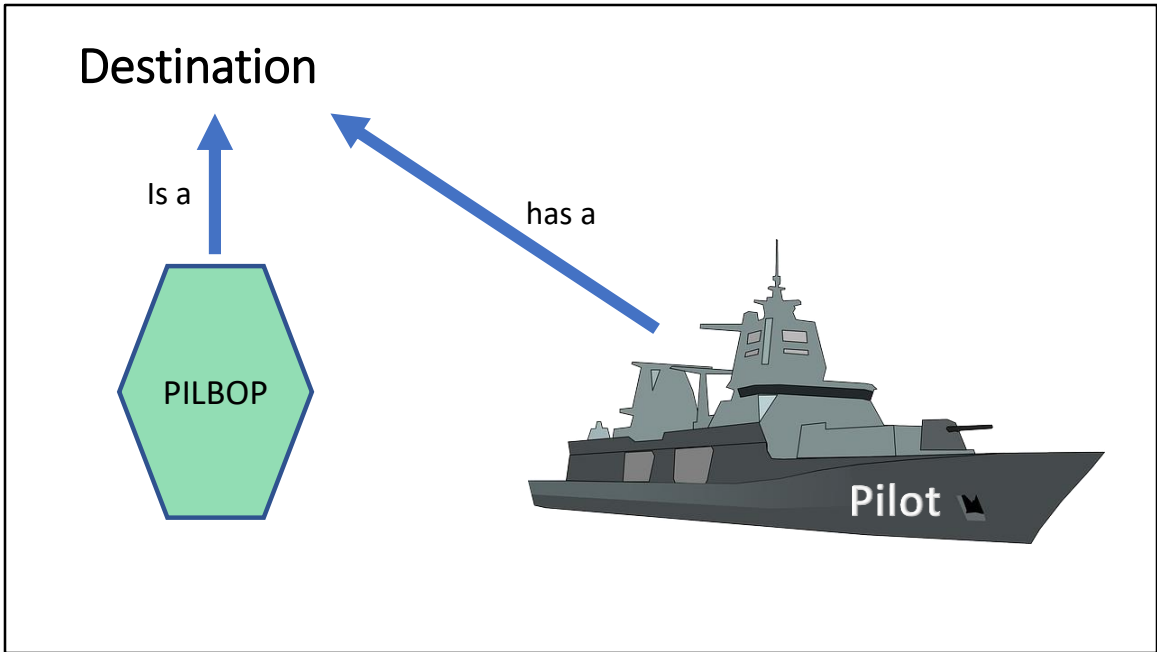
Should a boarding place have a destination or
Should a boat / pilot service have a destination?

Which seems more intuitive to you?

Currently in S-127 as:

PILBOP —has one→ Destination – type text

Right now the Pilot Boarding Place carries the attribute destination a text data type.

Recommended change:

Destination – type MRN

has many

Pilot
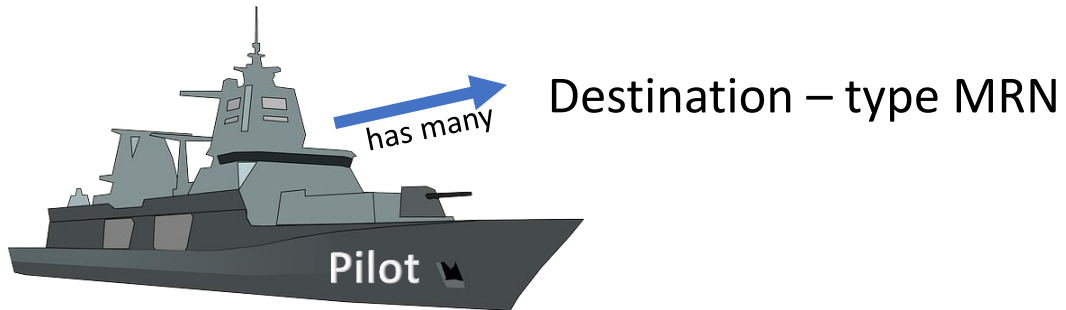
Ideally, we want to associate the destinations with an ENC feature so we can capture relationships to features. (To allow for INTEROPERABILITY with ENC).
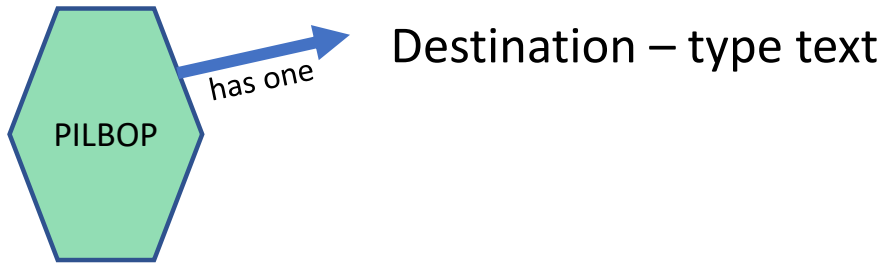Typically, destination would be a PILBOP or port so this would work.

1. This would keep the place of boarding responsible only for the specific details related to it.
2. This would eliminate the suggestion to create multiple identical Pilot Boarding Places that have all the same information but different destination values.

Argument against the changes:

Destination – type text to accommodate for "upriver", "inbound"

counter-argument: these are not "destinations" they are headings
create a new attribute for headings (could then include
cardinal directions as well, could even make them enums)

Programmer Opinion: If we want this to be robust for amazing things in the future the more computer friendly this is the better!

Naysayer caution: if it doesn't add value with the extra work then don't do it!

Pilot Vessel Description

(64) The pilot boats are 50 feet long with black hulls and white houses with the word "PILOT" in large letters on each side. The pilot station and pilot boats may be contacted on VHF-FM channels 14 and 16. The pilots carry portable radiotelephones for bridge-to-bridge communications on VHF-FM channel 13.
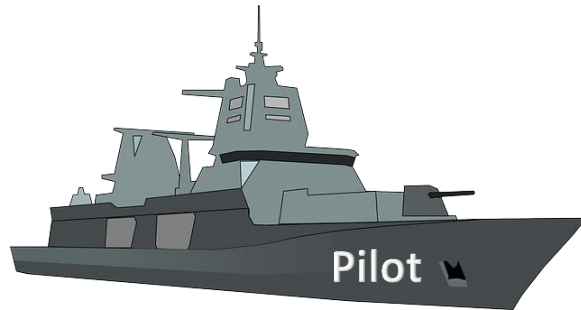
Here is a case from the U.S. Coast Pilot when a pilot boat is described so the mariner knows what to look for, however, there is no allowance for this kind of information other than a possible text field.

This MAY BE GOOD ENOUGH…..

(64) The pilot boats are 50 feet long with black hulls and white houses with the word "PILOT" in large letters on each side. The pilot station and pilot boats may be contacted on VHF-FM channels 14 and 16. The pilots carry portable radiotelephones for bridge-to-bridge communications on VHF-FM channel 13.

Pilot Vessel Description – Applicability Info Type

```xml
<S127:Applicability gml:id="CB.APPLIC.pilotVessel.50">
        <featureName>
            <name>Pilot Boat</name>
        </featureName>
        <categoryOfVessel>service</categoryOfVessel>
        <information>
            <headline>Description</headline>
            <text>black hulls and white houses with the word "PILOT" in
large letters on each side.</text>
        </information>
        <vesselsMeasurements>
            <comparisonOperator>equal to</comparisonOperator>
            <vesselsCharacteristics>length overall</vesselsCharacteristics>
            <vesselsCharacteristicsValue>50</vesselsCharacteristicsValue>
            <vesselsCharacteristicsUnit>foot</vesselsCharacteristicsUnit>
        </vesselsMeasurements>
        <vslLocation xlink:href="#CB.PLTSRV.PABRD"
xlink:arcrole="http://www.iho.int/s127/gml/1.0/roles/permission"/>
        </S127:Applicability>
```
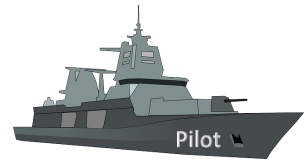
However, much of this data could be represented using the Applicability Information type!
Which I was able to do to bend the product to my own desires….however, programmers following the S-127 wouldn't associate my use of applicability to following the standard even though this GML "passed the test" for conforming to the standard.

Recommended change:

1. Add ability to describe any vessels details without being an "Applicability" info type.
   1. Instead Applicability would be an association type
   2. This would also allow applicability to be reused for other things (like weather, seasons, times of day, activities, etc)

2. OR Add more attributes to Applicability for more robust descriptions and extend use of applicability for Pilot/Other vessels.

The ability to describe any vessel would promote reusability and could be better suited for possible use outside the Traffic Services domain.

More robust descriptions would allow for more computer-friendly options in the future…who knows how insightful developers may end up using this data later on! Think modelling vessels on the fly or attaching pictures with same descriptions that can be reused, simulations, vessel dynamics etc.

Argument against the changes:

Vessel descriptions – Pilot Vessel can be replaced with no notice. (The source of this information is said to be the critical component.)

counter-argument: this could easily be stated in the extra information text for all Vessel *Services with a vessel description. Thereby keeping all data contained within the publications intact.*

Other observations:

(60) **Quoddy Pilots boat MEDRIC II is a 48-foot long black-hulled fishing vessel, and when on station it displays International Code flag H by day and a white light over red light at night.** The pilot boat and station monitor VHF-FM channels 14 and 16 and work on channel 65A. The pilot boat cruising and boarding station is about 1 mile eastward of East Quoddy Head at the north end of Campobello Island. **Vessels are requested to locate the pilot boarding ladder on the port side at the water's edge and make the best possible lee for pilot boarding.** **Foul weather and sea conditions may affect boarding time.** A 24-hour estimated time of arrival is requested.

Bold items – other descriptions that seem to be value added.

Blue item – weather related conditions...could be value-added to link to weather warnings for vessels arranging for a pilot.

<table>
<tr><td rowspan="2">Action required of NIPWG:</td><td>❑ **give feedback on the recommendations listed to be included for Version 2.0.0**
  ❑ Destination attribute be moved to Pilot Services
  ❑ Multiple destinations allowed
  ❑ Destination to contain MRN to link to S-101 feature
  ❑ Vessel descriptions with extended attributes
  ❑ Applicability to be association instead of info type
❑ **discuss possibility of interoperability**:
  ❑ with S-101 and using MRN to link to features
  ❑ The usefulness of S-124 weather warnings related to Pilot Boarding operations.
  ❑ and open up a dialog with the associated working groups as to our findings and recommendations.</td></tr>
</table>

I'd like to now discuss each of these points and get concrete feedbacks and take concrete steps towards resolving these items before I finish my time here.

Thanks

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