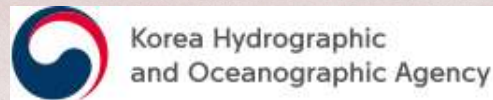


# **S-100 application status and plan in hydro and maritime safety domain of Korea**

**Sewoong OH (KRISO)**



# Introduction

**Name :** Sewoong OH (osw@kriso.re.kr)

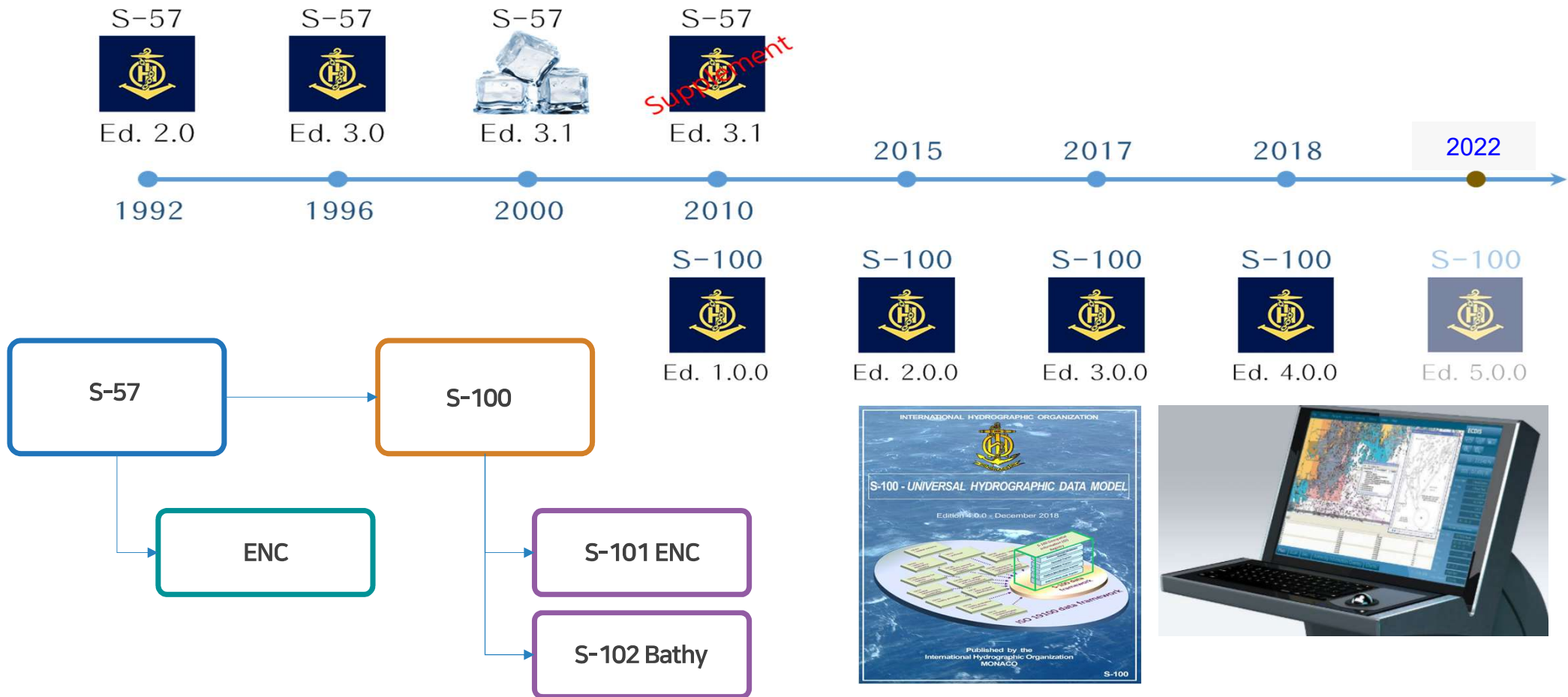
**Organization :** (KRISO) Korea Research Institute of Ship and Ocean Engineering

## Main activities

- IHO S-100WG, NIPWG member (S-128 PT, S-125 PT)
- IHO S-130 PT member
- Involved in the development of IHO GI Registry
- IALA ARM Committee member, S-201 project leader
- Project lead of KHOA S-100 Testbed project
- Project lead of SMART Aton project in Korea
- Lead of Hydro(ENC/NPUB/NW) Service in Korean e-Navigation Project
- Technical lead of type approval test on ECS for Korean e-Nav service

# S-100 (Universal Hydrographic Data Model)

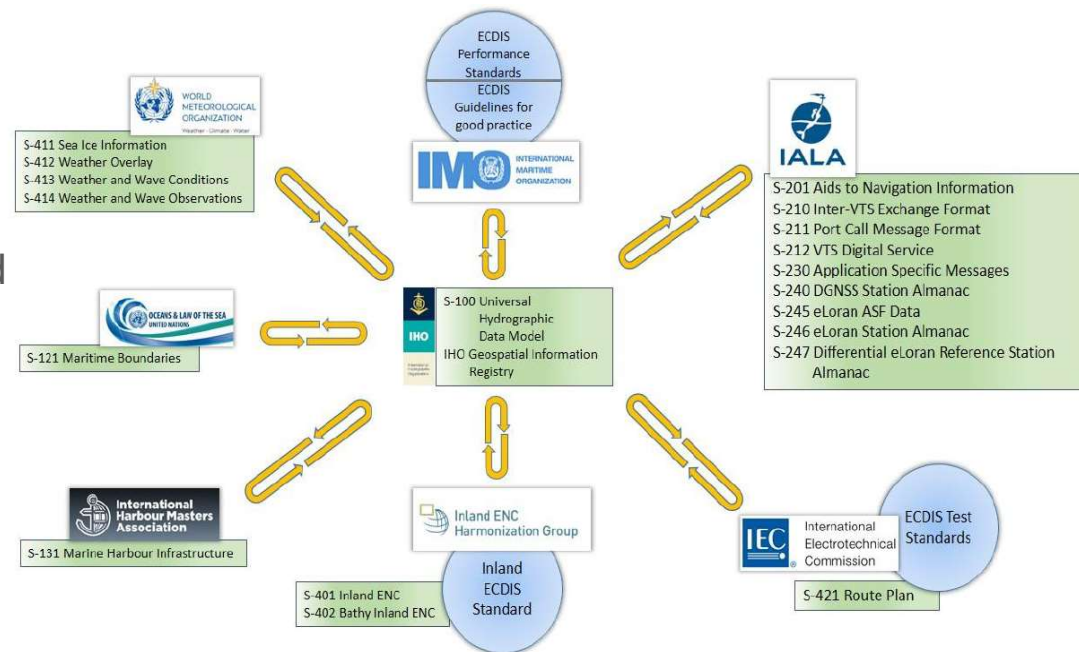
## Profile from ISO/TC 211 Geo-spatial Standard



# S-100 (Universal Hydrographic Data Model)

## Each domain decides to join the S-100

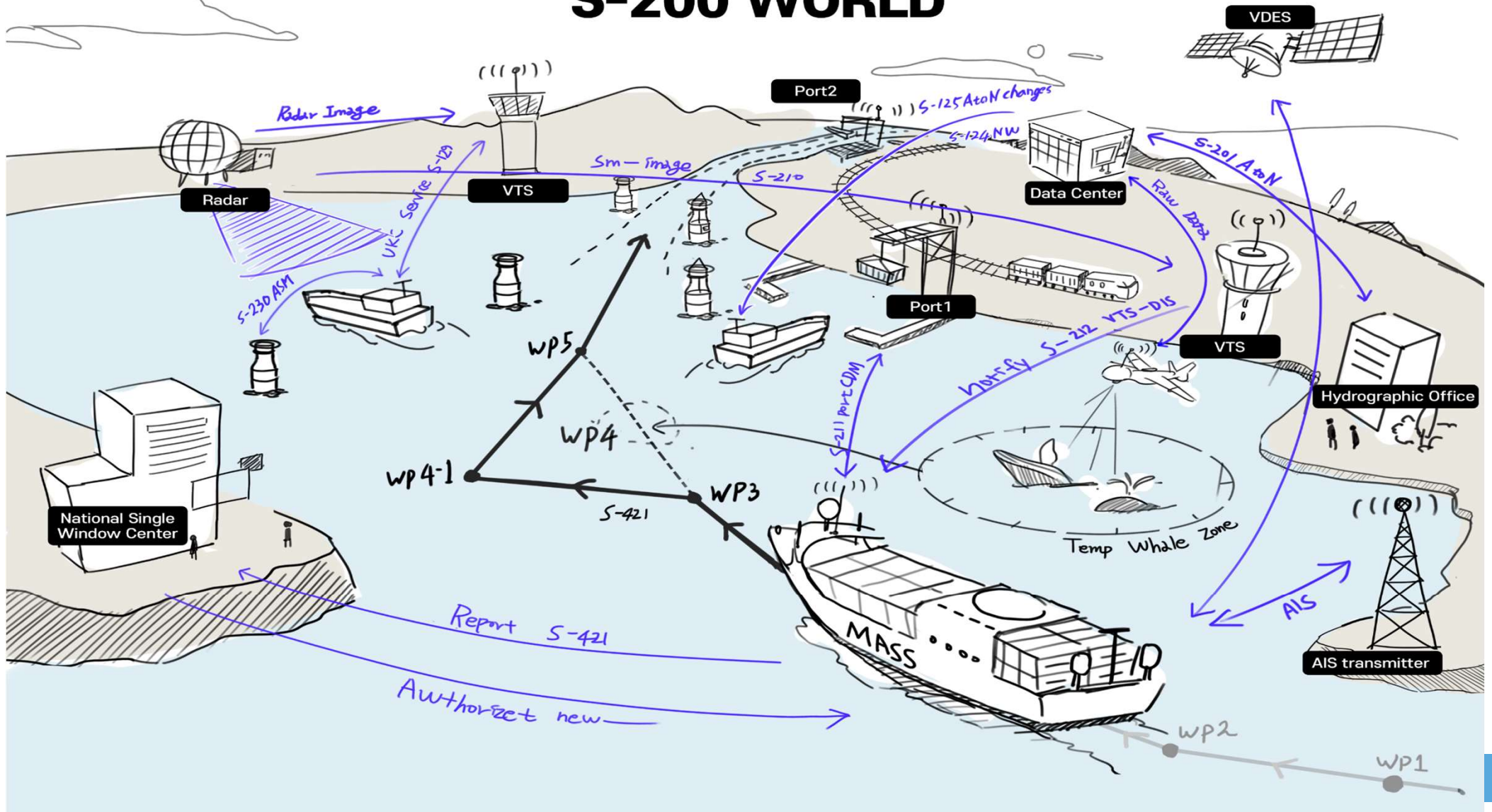
- IHO (International Hydrography Organization)
  - Electronic Navigational Charts
  - Nautical Publications, Surface Currents
  - Bathymetric Surface
- IALA (International Association of Marine Aton and Lighthouse Authorities)
  - AIS / VTS / ATONs
- WMO (World Meteorological Organization)
  - Ice / Weather Overlay
- IMO (International Maritime Organization)
  - E-navigation, Single Window



# S-100 (Universal Hydrographic Data Model)



# S-200 WORLD



# S-100 based Product Specifications

## General Document

- S-97 Guidelines for Creating S-100 Product Specifications
- S-98 Data Product Interoperability in S-100 Nav Systems
- S-99 Operational Procedures for the Organization and Management of the IHO GI registry
- S-100 IHO Universal Hydrographic Data Model

## International Hydrographic Organization (IHO) (S-101 to S-199)

- S-101 Electronic Navigational Chart (ENC)
- S-102 Bathymetric Surface
- S-103 Sub-surface Navigation
- S-104 Water Level Information for Surface Navigation
- S-111 Surface Currents
- S-112 Open - (See Decision HSSC9/38)
- S-121 Maritime Limits and Boundaries
- S-122 Marine Protected Areas
- S-123 Marine Radio Services
- S-124 Navigational Warnings
- S-125 Marine Aids to Navigation (AtoN)
- S-126 Marine Physical Environment
- S-127 Marine Traffic Management
- S-128 Catalogue of Nautical Products
- S-129 Under Keel Clearance Management (UKCM)
- S-130 Polygonal Demarcations of Global Sea Areas
- S-131 Marine Harbour Infrastructure
- S-164 IHO Test Data Sets for S-100 ECDIS

## International Association of Marine Aids to Navigation and Lighthouse (IALA) (S-201 to S-299)

- S-201 Aids to Navigation Information
- S-210 Inter-VTS Exchange Format
- S-211 Port Call Message Format
- S-212 VTS Digital Service / S-230 Application Specific Messages
- S-240 DGNSS Station Almanac
- S-245 eLoran ASF Data / S-246 eLoran Station Almanac
- S-247 Differential eLoran Reference Station Almanac

## WMO Service Commission (SERCOM) (S-411 to S414)

- S-411 Ice Information
- S-412 Weather and Wave Hazards
- S-413 Weather and Wave Conditions
- S-414 Weather and Wave Observations

## International Electrotechnical Commission - TC80 (IEC-TC80) (S-421 to S-430)

- S-421 Route Plan

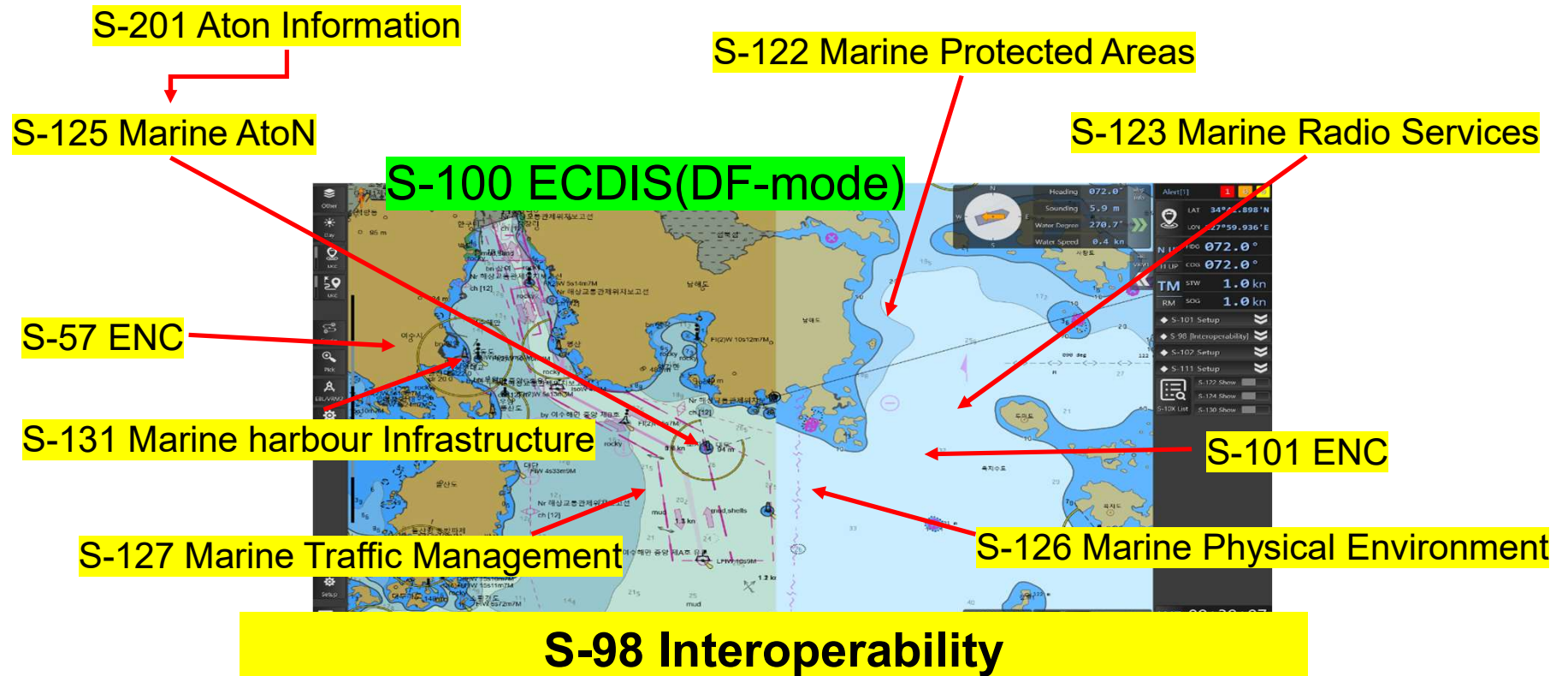
## Inland ENC Harmonization Group (IEHG) (S-401 to S-402)

- S-401 IEHG Inland ENC / S-402 IEHG Bathymetric Inland ENC

# Hydrographic domain

## Future ECDIS supporting E-navigation

ECDIS with multiple interoperable layers adding the vertical and real time information dimension to the main ENC layer



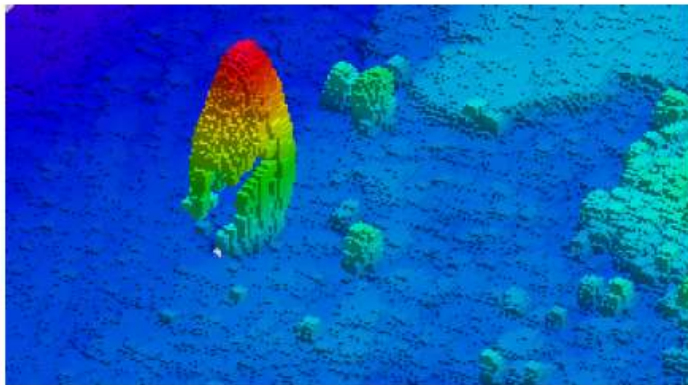


# Hydrographic domain

## Major Benefits with S-100

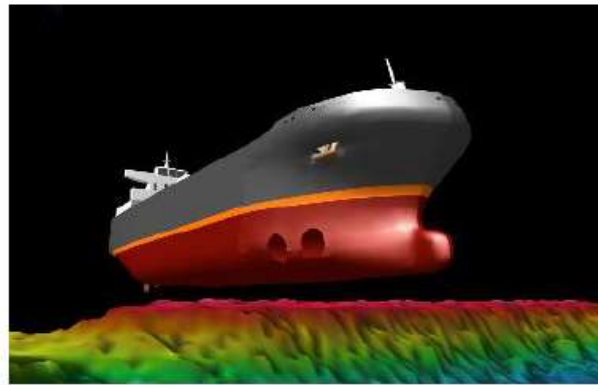
Increased Safety, Efficiency and Reduced Environmental Impact

### Improved Safety



High resolution bathymetry in combination with other datasets.

### Optimized Loading



Under Keel Clearance Management with S-100

### Route Optimization and Just in Time



Decreased fuel consumption. Avoid squat, usage of tide, currents and weather information

# Hydrographic domain

## Major Benefits with S-100

Cyber secure, optimal decision aids, multiple usage beyond safety of navigation, future proof and a first step towards MASS

### Maintainable and Cyber Secure



Updates of S-100 Product Specifications can be managed in S-100 ECDIS and Cyber Security is improved.

### Automated Navigation



Machine readable nautical information can facilitate IMO MASS – Maritime Autonomous Surface Ships

# Hydrographic domain

## Fundamental changes in S-100 ECDIS

- The single layer official S-57 ENC's will be replaced by multiple, interacting layers of navigational data
- The S-101 ENC will always be the navigational base layer
- In the new IMO ECDIS Performance Standards the term *Electronic Navigational Data Service (ENDS)* is used for the multiple layers to be used in S-100 ECDIS
- ***Electronic Navigational Data Service (ENDS)*** means a special-purpose database compiled from nautical chart and nautical publication data, standardized as to content, structure and format, **issued for use with ECDIS by or on the authority of a Government, authorized Hydrographic Office or other relevant government institution**, and conforming to IHO standards; and, is designed to meet the requirement of marine navigation and the nautical charts and nautical publications carriage requirements in SOLAS regulations V/19 and V/27. **The navigational base layer of ENDS is the Electronic Navigational Chart (ENC).**
- S-98 is the product specification which will handle how multiple layers are portrayed and how alarms are triggered

# Hydrographic domain

## S-100 implementation Priorities

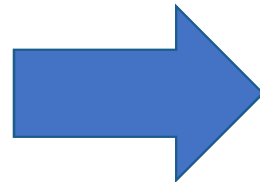
### First step

#### Navigational Route Monitoring Mode

S-101 ENC  
S-102 Bathymetry  
S-104 Water Level  
S-111 Surface Currents  
S-124 Navigational Warnings  
S-129 UKC Management

#### Critical Framework

IHO Geospatial Information Registry  
S-98 Interoperability Specification  
S-100 Universal Hydrographic Data Model  
S-128 Catalogue of Nautical Products  
S-164 Test Data Set for S-100 and ECDIS  
Type Approval



### Next step

#### Navigational Route Planning Mode

S-122 Marine Protected Areas  
S-123 Marine Radio Services  
S-125 Marine Aids to Navigation (AtoN)  
S-126 Marine Physical Environment  
S-127 Marine Traffic Management  
S-131 Marine Harbour Infrastructure

+ S-100 Products used in  
Monitoring Mode

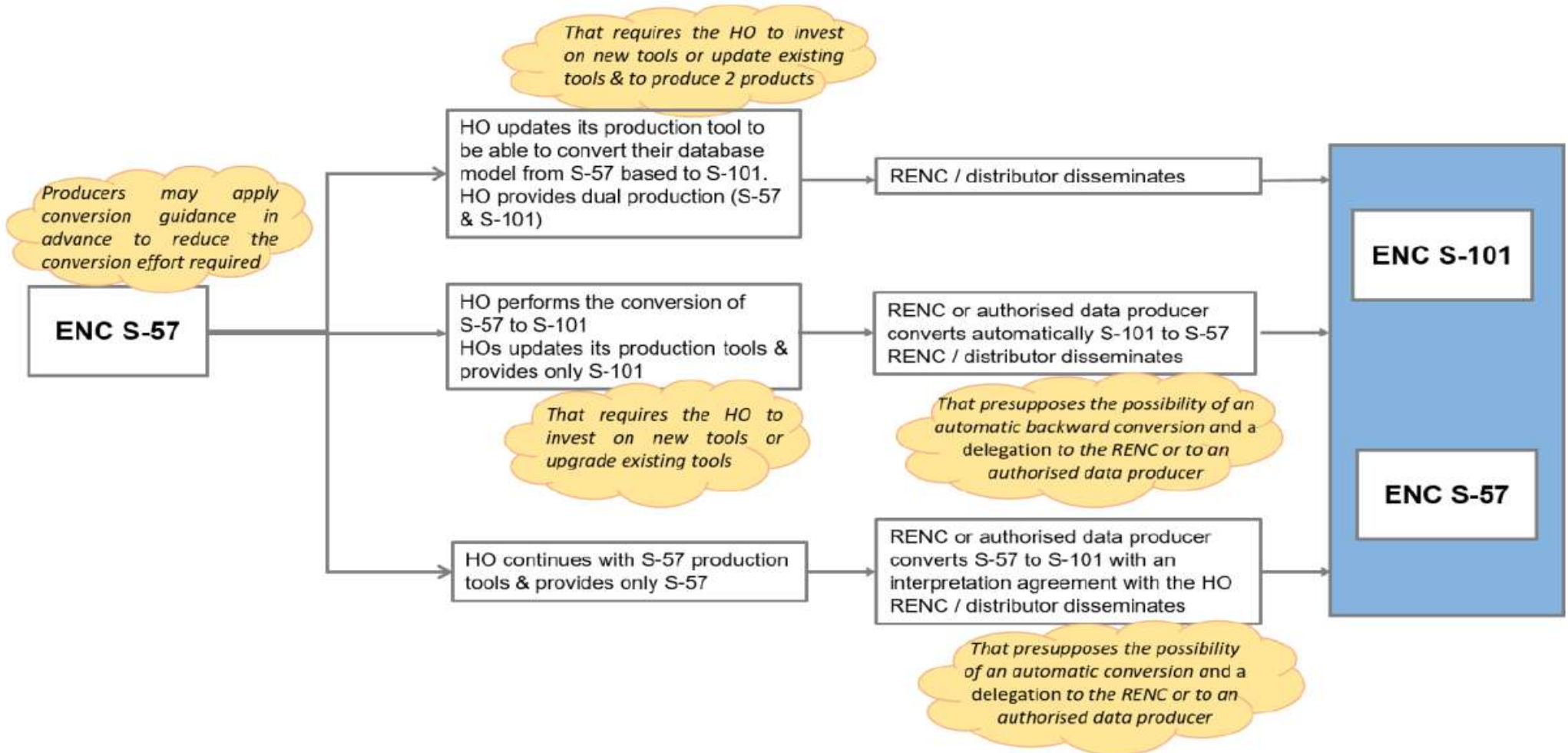
# Hydrographic domain

## Transition from S-57 to S-101 ENC

- ENCWG has developed a S-57 ENC to S-101 Conversion Guidance which was approved in its first edition at HSSC14. For implementation and testing. Published as S-65 Ed 1.0.0.
- HSSC14 also tasked the ENCWG to develop an encoding guidance for the backward conversion from S-101 to S-57. It is expected that the backwards conversion would be a more automatic process.
- The IHO-Singapore Tech Lab, IC-ENC and PRIMAR have ongoing activities regarding S-57 to S-101 conversion and vice versa.
- All these initiatives are aimed to support the transition from S-57 ENCs to S-101 ENCs, so IHO MS can achieve substantial coverage of S-101 ENC in advance of the new IMO ECDIS Performance Standards in force dates.

# Hydrographic domain

## Options for HOs on parallel production S-57 and S-101



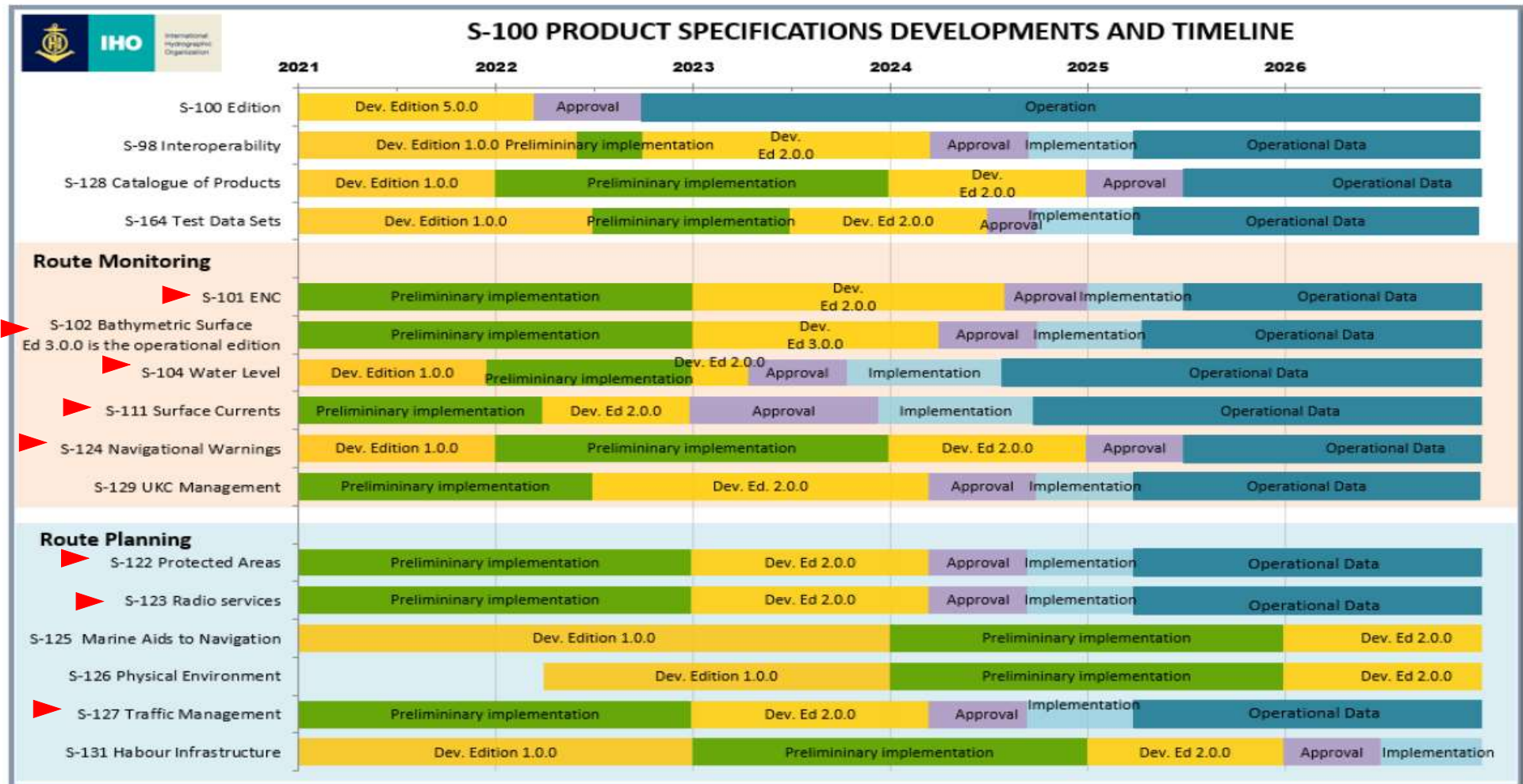
# Hydrographic domain

## IMO Approval of S 100 in ECDIS Performance Standards

- The IHO organized a drafting group consisted of relevant parts of the HSSC Chair group, CIRM, IEC, INTERTANKO and a few other relevant stakeholders.
- The drafting group was chaired by the IHO Technical Director and a draft redline version was submitted by IHO, cosponsored by CIRM and Intertanko, to the IMO NCSR9 meeting, held in June 2022.
- With the exception of the withdrawal of functionalities for route exchange all other proposed changes were endorsed by NCSR9. The proposal was subsequently approved by IMO MSC106 in November 2022.
- A transition period was agreed upon, meaning that S-100 ECDIS will be legal to use after **1 January 2026** and from **1 January 2029** new systems must comply with the new IMO Resolution MSC.530(106) on ECDIS Performance Standards.
- Member States to achieve substantial coverage of S-101 by 2026. Coordinated by IRCC, WENDWG and RHC.
- S-100 ECDIS legal to use, 1 January 2026, at the end of the IHO work programme 2023 – 2026.

# Hydrographic domain

## S-100 Timeline





# Hydrographic domain

## Review Cycle for WG/PT Development Phase (Edition 1 to Edition 2)



S-100 Ed 5.0.0 >>> 5.1.0 >>> 5.n.m  
 S-101 Ed 1.1.0 >>> 1.2.0 >>> 2.0.0  
 S-102 Ed 2.2.0 >>> 2.3.0 >>> 3.0.0  
 S-104 Ed 1.1.0 >>> ..... >>> 2.0.0  
 S-164 Ed 1.1.0 >>> ..... >>> 2.0.0  
 And so on ...

Edition 1.0.0 approved  
& published

Edition 2.0.0 approved  
& published

HSSC/IRCC approval  
required

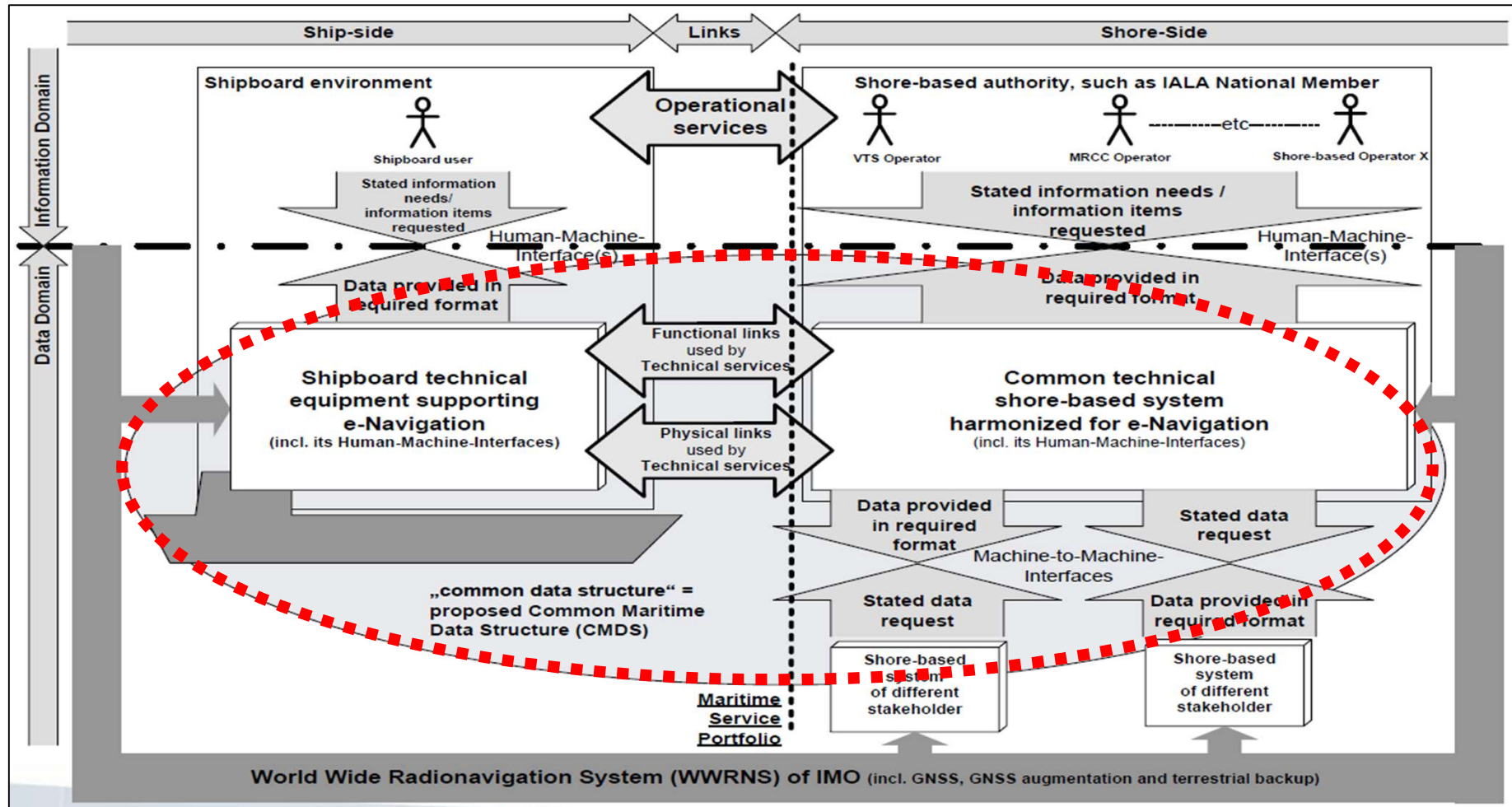
Revisions 1.n.n are issued by  
the WG/PT

HSSC/IRCC  
endorsement required

IHO Member State  
approval required

# E-Navigation project of Korea

## Architecture

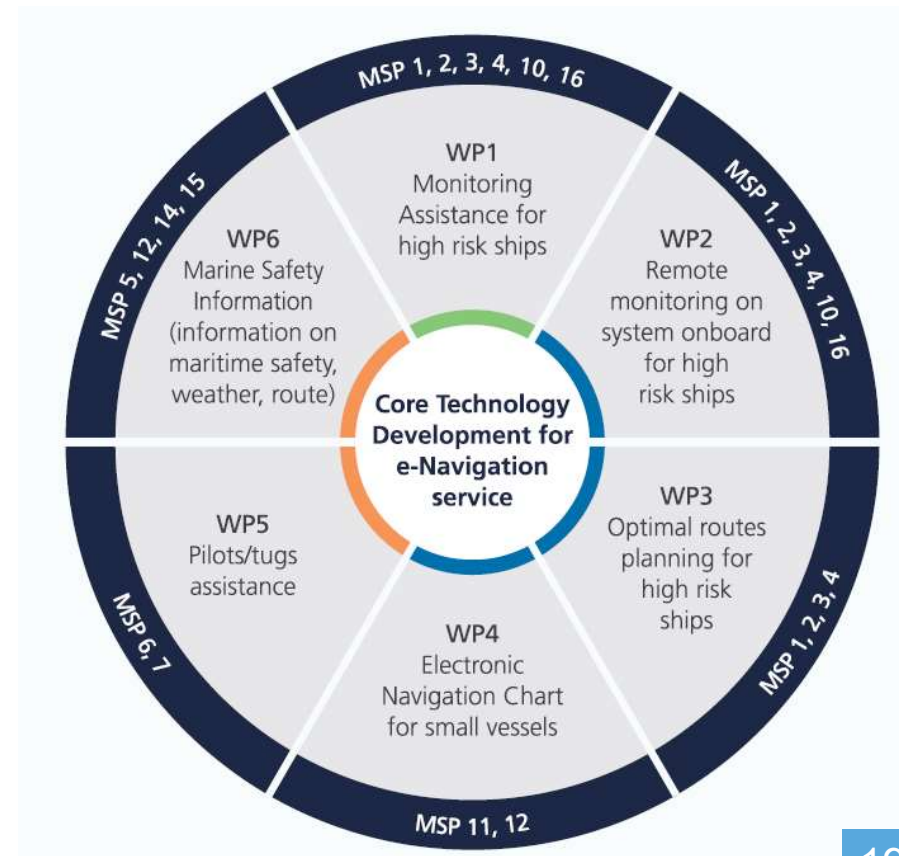
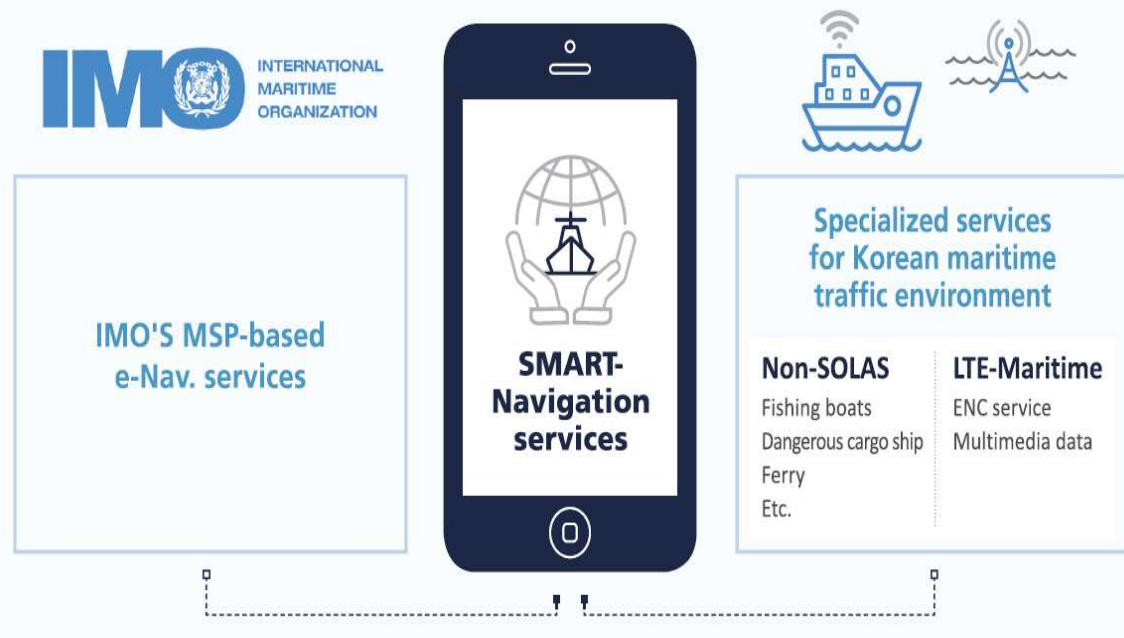


# E-Navigation in Korea

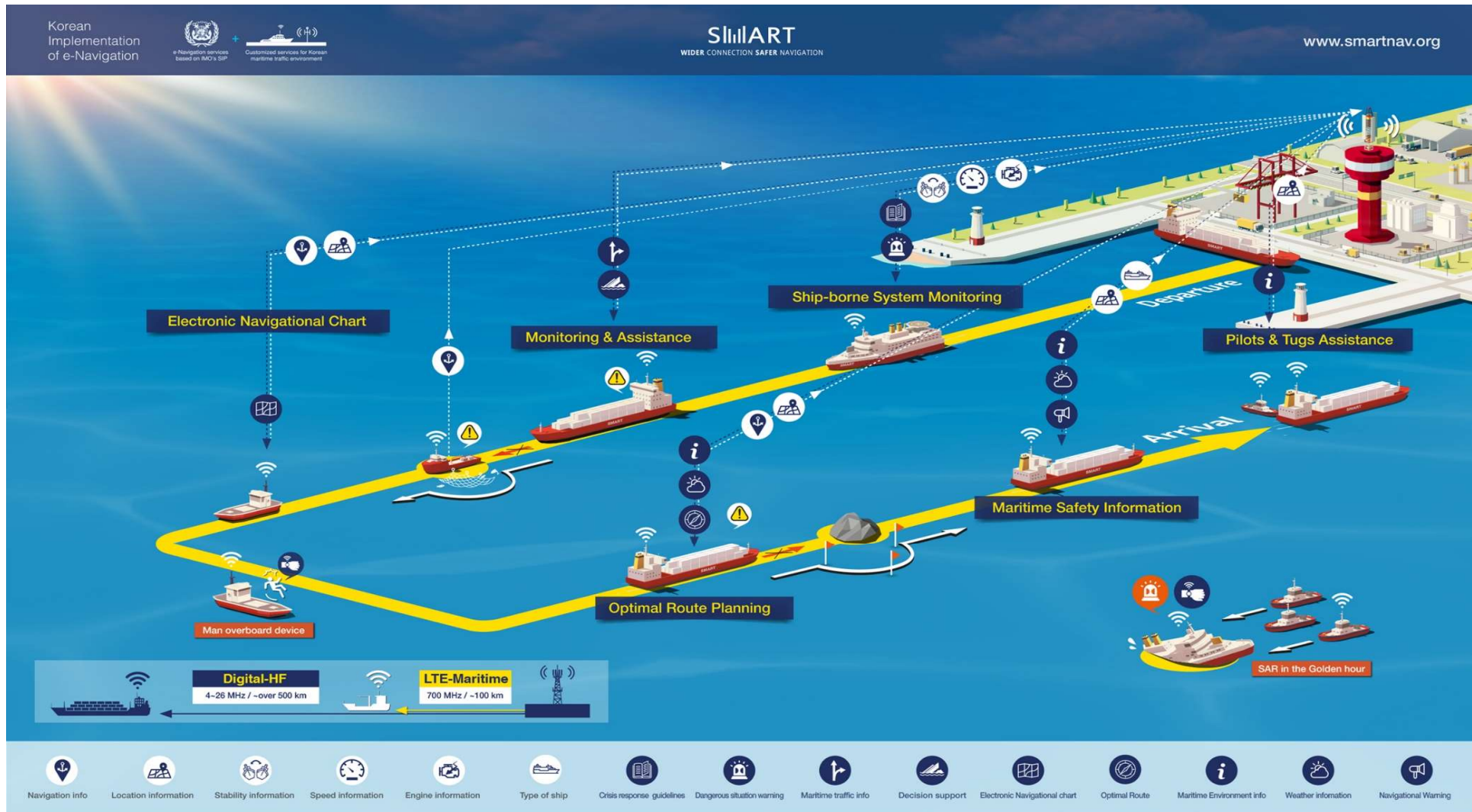
## SMART Navigation

### INTRODUCTION

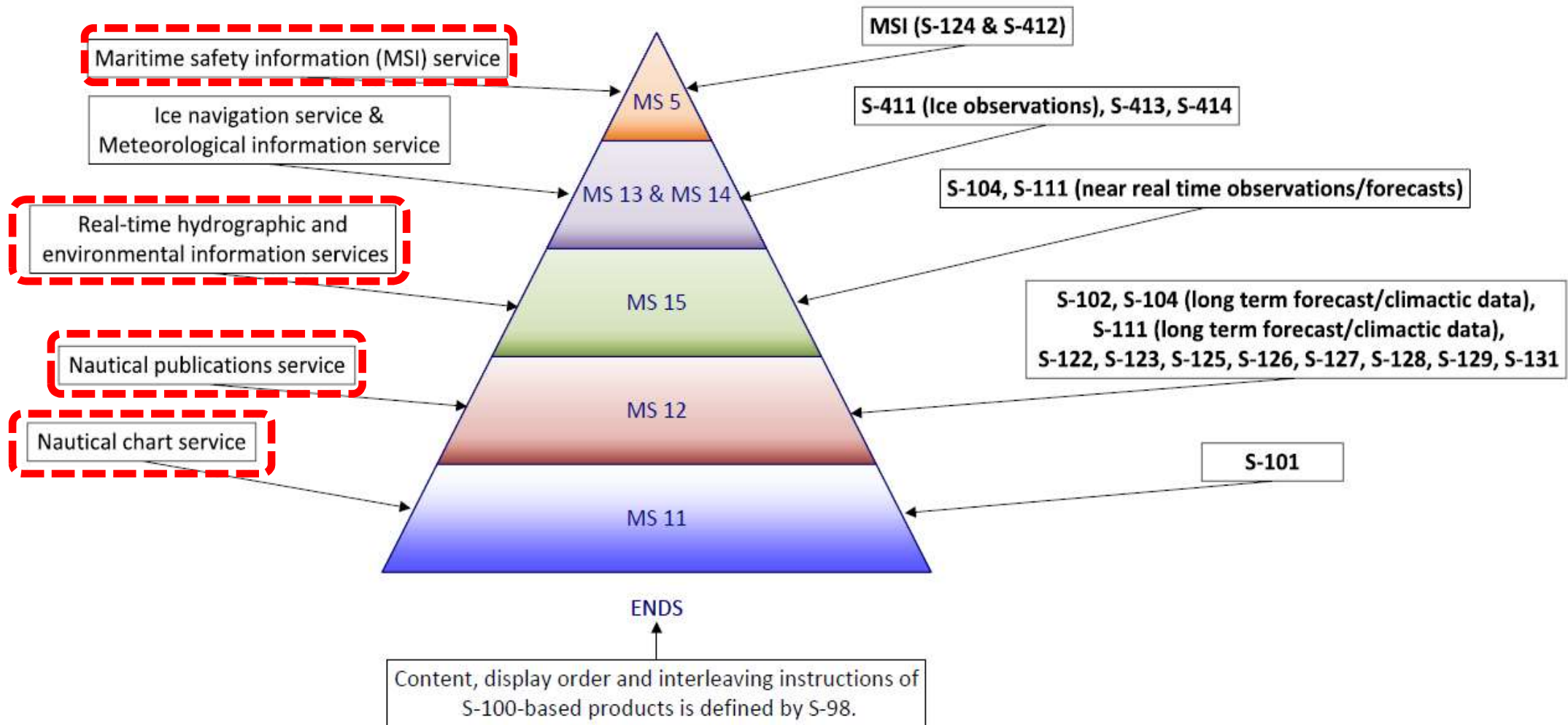
The SMART-Navigation implements the concept of IMO's e-Navigation, providing additional services for Non-SOLAS ships such as fishing boats, coastal vessels and small ferries.



# E-Navigation in Korea

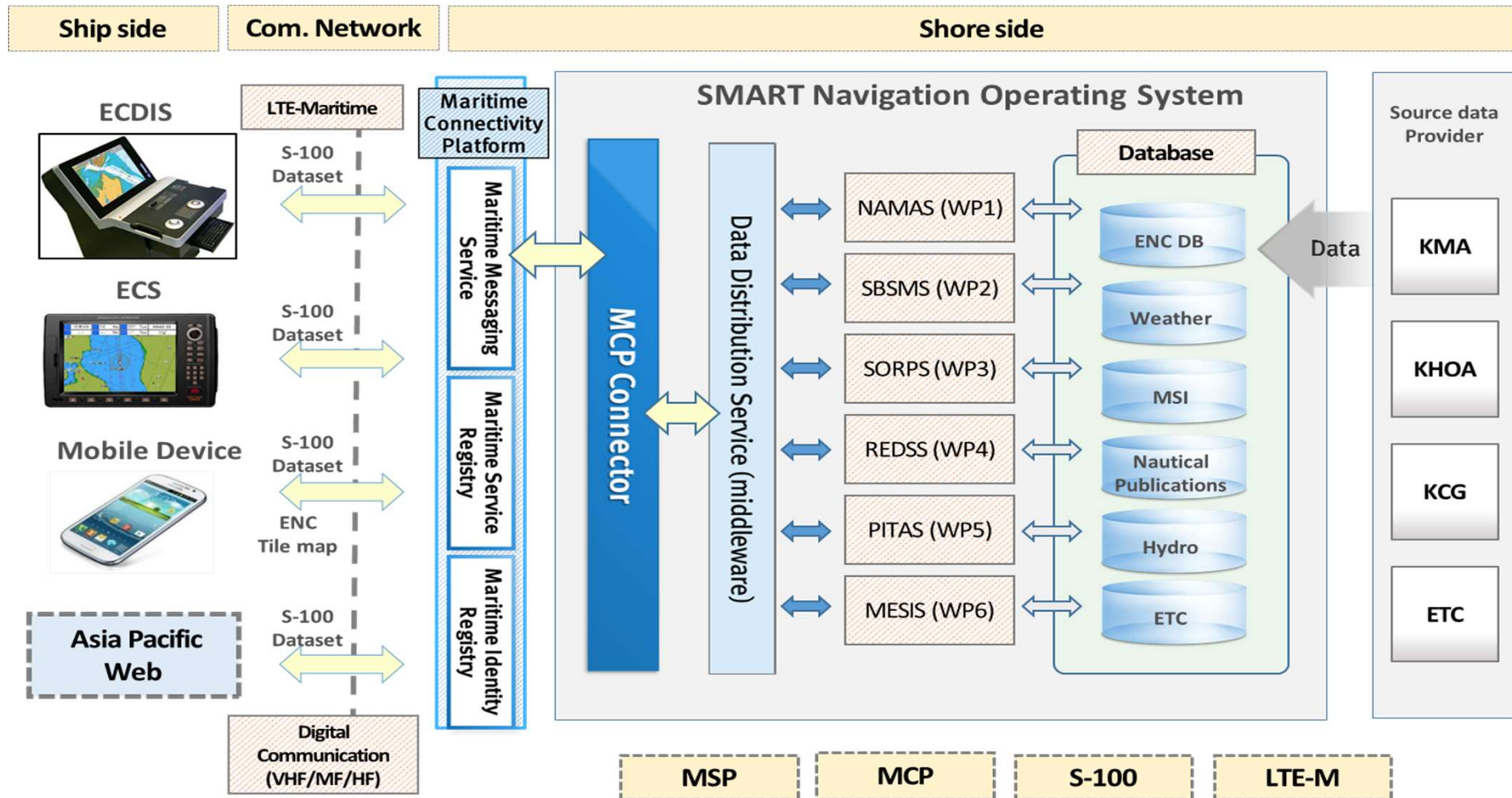


# E-Navigation in Korea



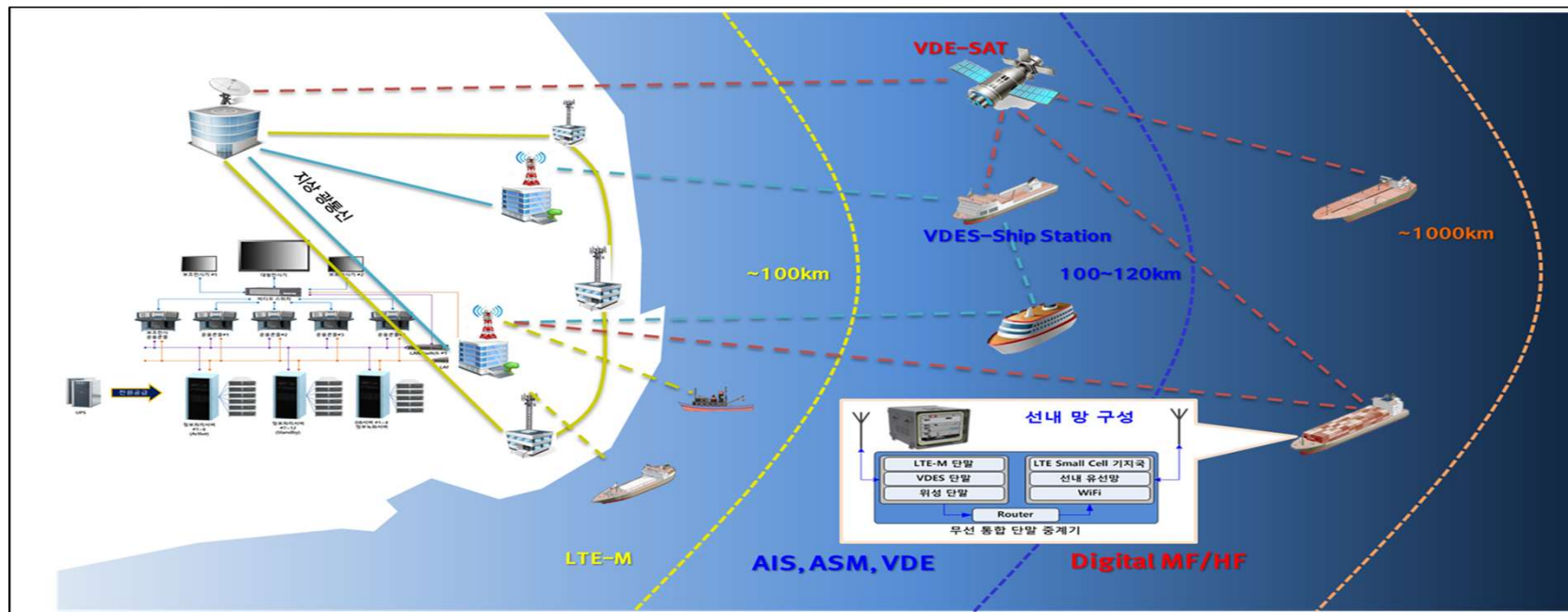
# E-Navigation in Korea

## Service Architecture



# E-Navigation in Korea

## Communication network



	Frequency	Range	Max. Speed	Usage	Business Scope
LTE-Maritime	700MHz band	100km	10Mbps	Domestic vessel within 100km	Nationwide
VDES	VHF	120km	307Kbps	Foreign vessel (International standard)	Pilot
Digital-HF	HF	1000km	51Kbps	Domestic vessel outside 100km	Pilot

# E-Navigation in Korea

## ECS Standard for SMART Navigation

### ECS Standard for SMART Navigation

This Standard specifies the minimum operational, performance and technical requirements and methods of testing for SMART Navigation compliant ECS

IEC 60945  
(General requirements)

IEC 61174  
(ECDIS requirements and testing method)

Class B level of ECS  
and  
Additional  
Requirements

IEC 62288  
(Presentation of navigation related info)

IEC 61162-1, 61162-2  
(Digital interfaces)

#### S-101 and S-10X datasets

- ▶ S-101 ENC
- ▶ S-104 Water level for Navigation
- ▶ S-111 Surface Current
- ▶ S-124 Navigational Warnings
- ▶ S-12X Nautical Publications

#### SMART Navigation Service Based on S-100

- ▶ Message service for collision and grounding accident
- ▶ Remote monitoring service
- ▶ Optimal route planning service
- ▶ ENC service
- ▶ Marine information service

#### Interoperability Requirement

- ▶ Interoperability catalogue
- ▶ Files describing how an ECS must combine data products conforming to different product specifications for display purposes

#### LTE-M Router Interface

- ▶ Define the digital interfaces to link to the LTE-M Router



# E-Navigation in Korea

## ECDS for SMART Navigation

- LTE-M망(최대 100km 해상) **e-Nav 선박단말기**
- 상용통신망(최대 30km) **e-Nav 앱**

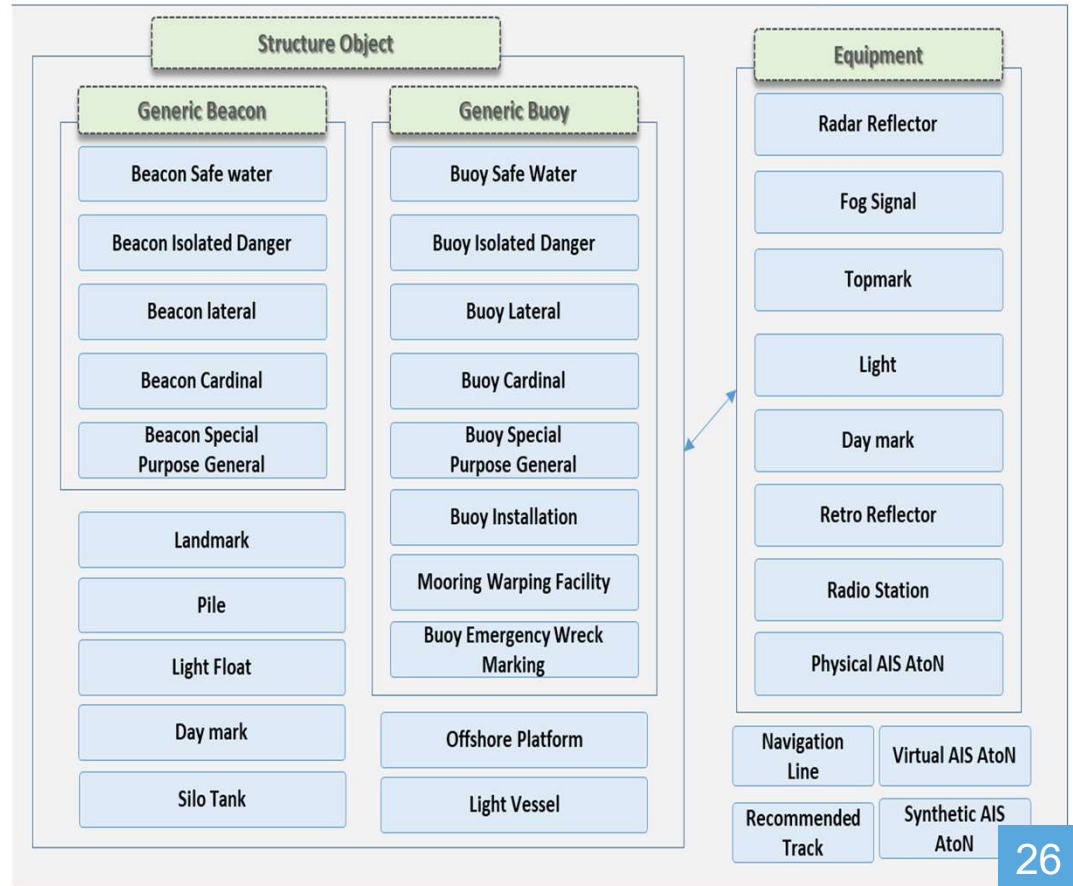
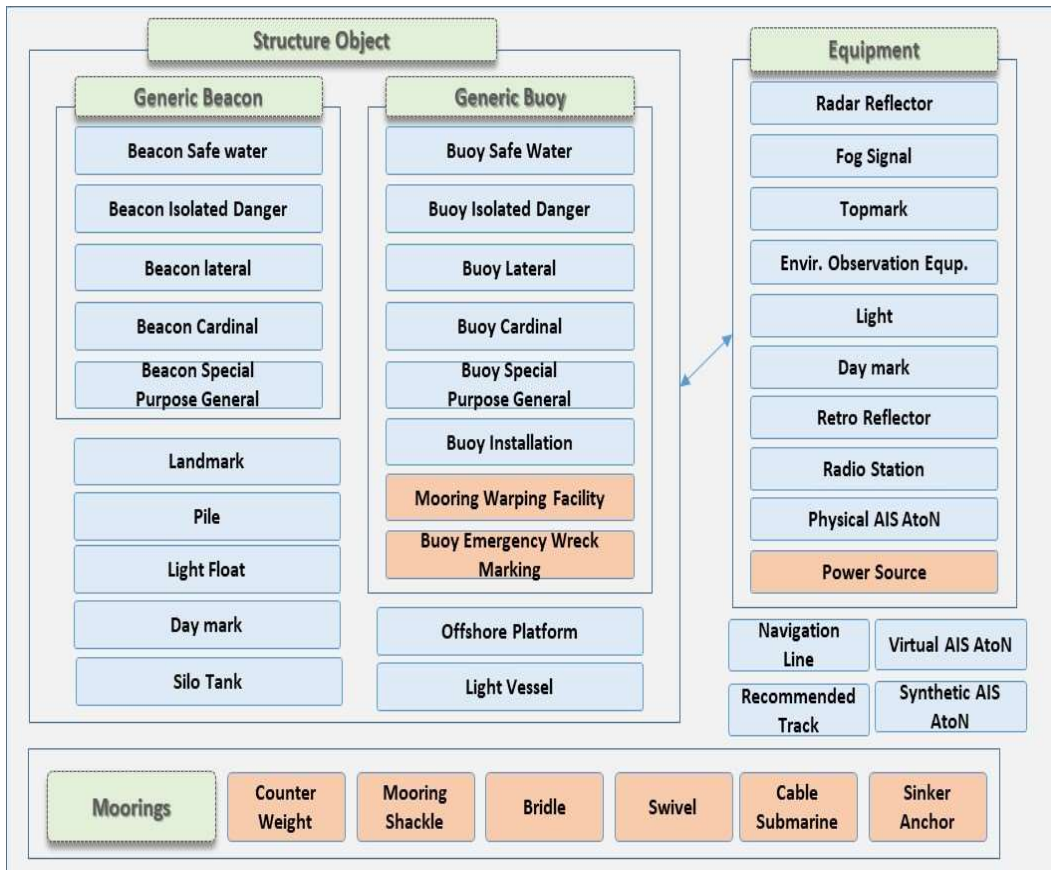


# AtoN Information

## Data model and MRN

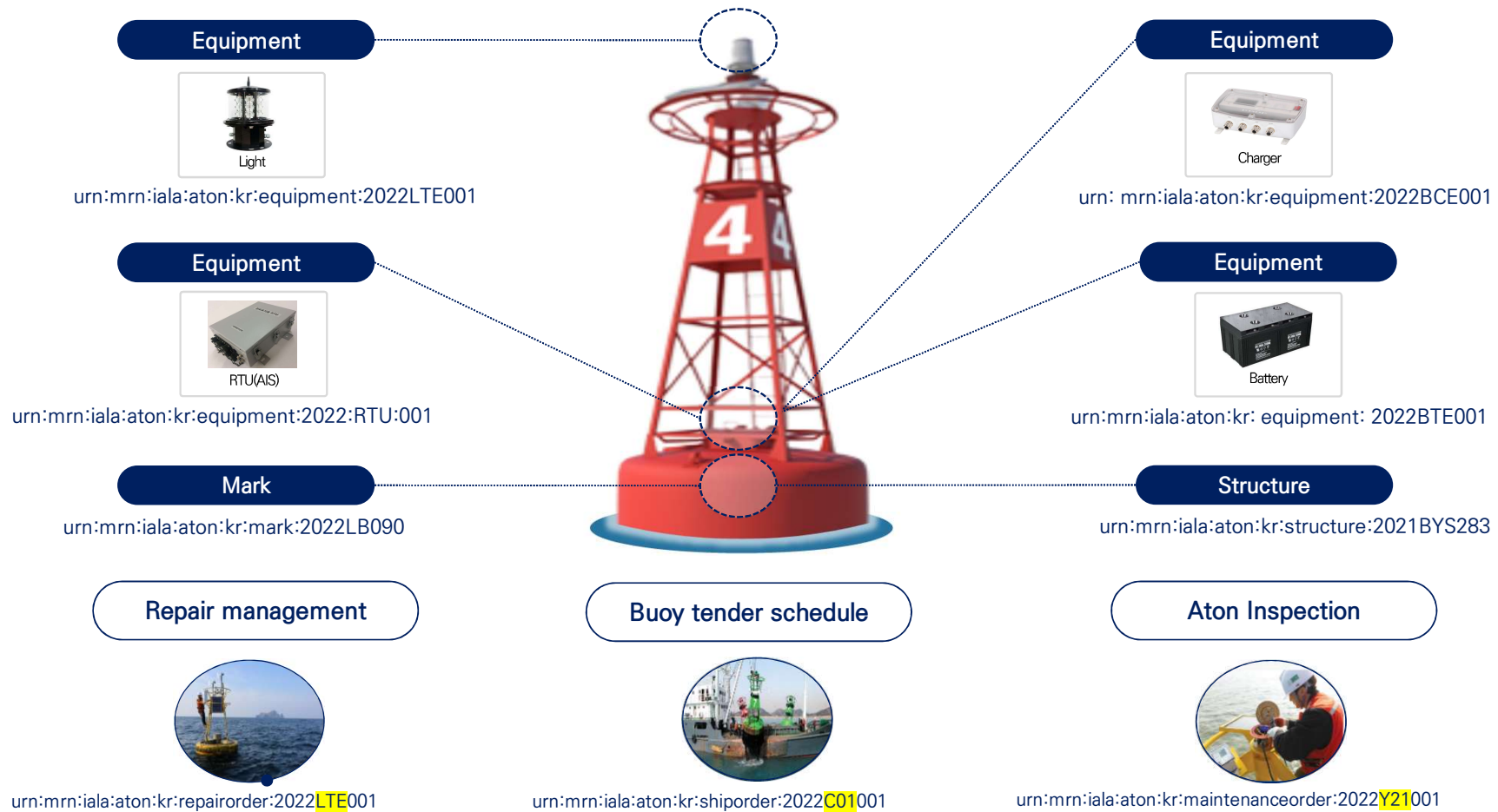
S-201 and S-125

(Information type)  
AtoN Status Information



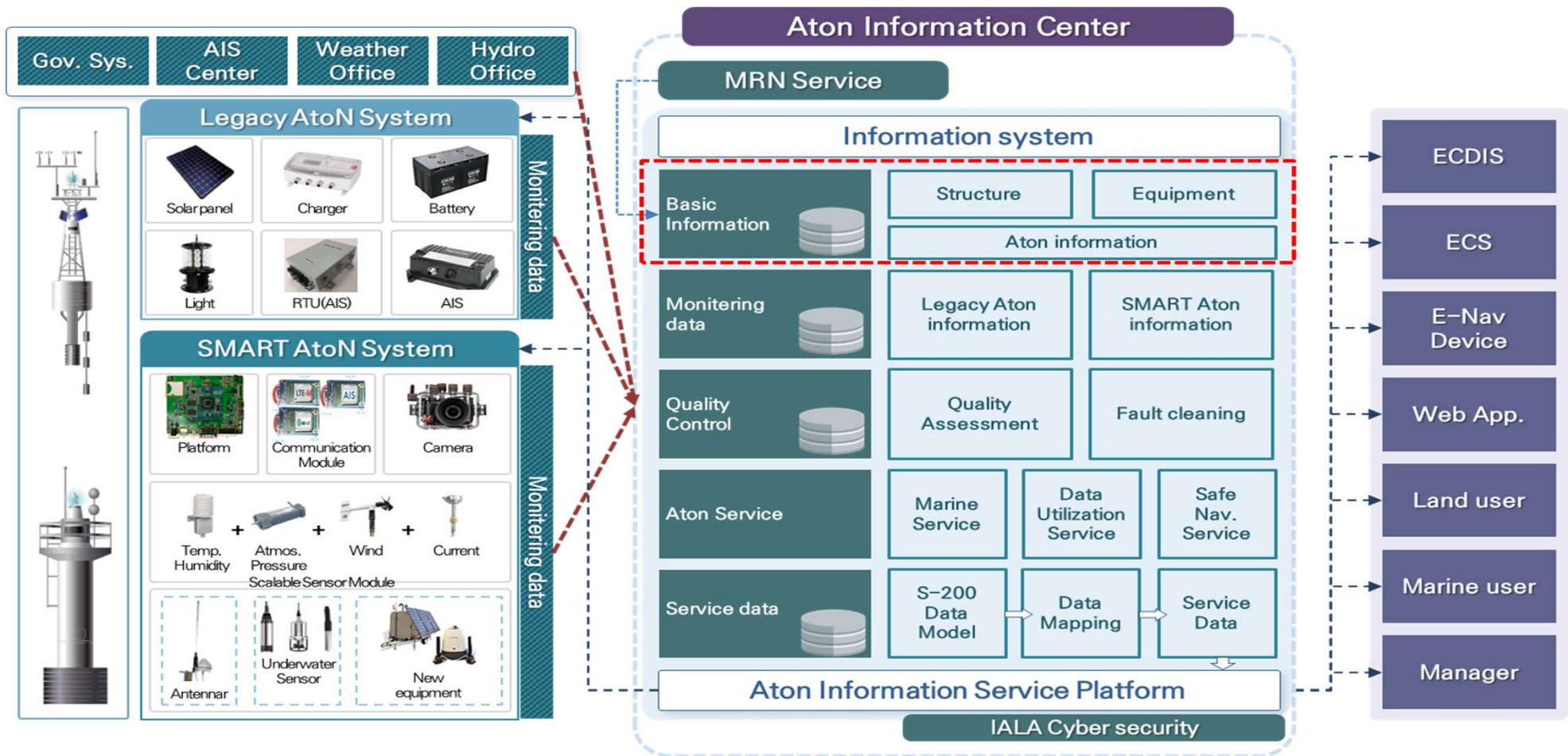
# AtoN Information

## Equipment and Structure with MRN



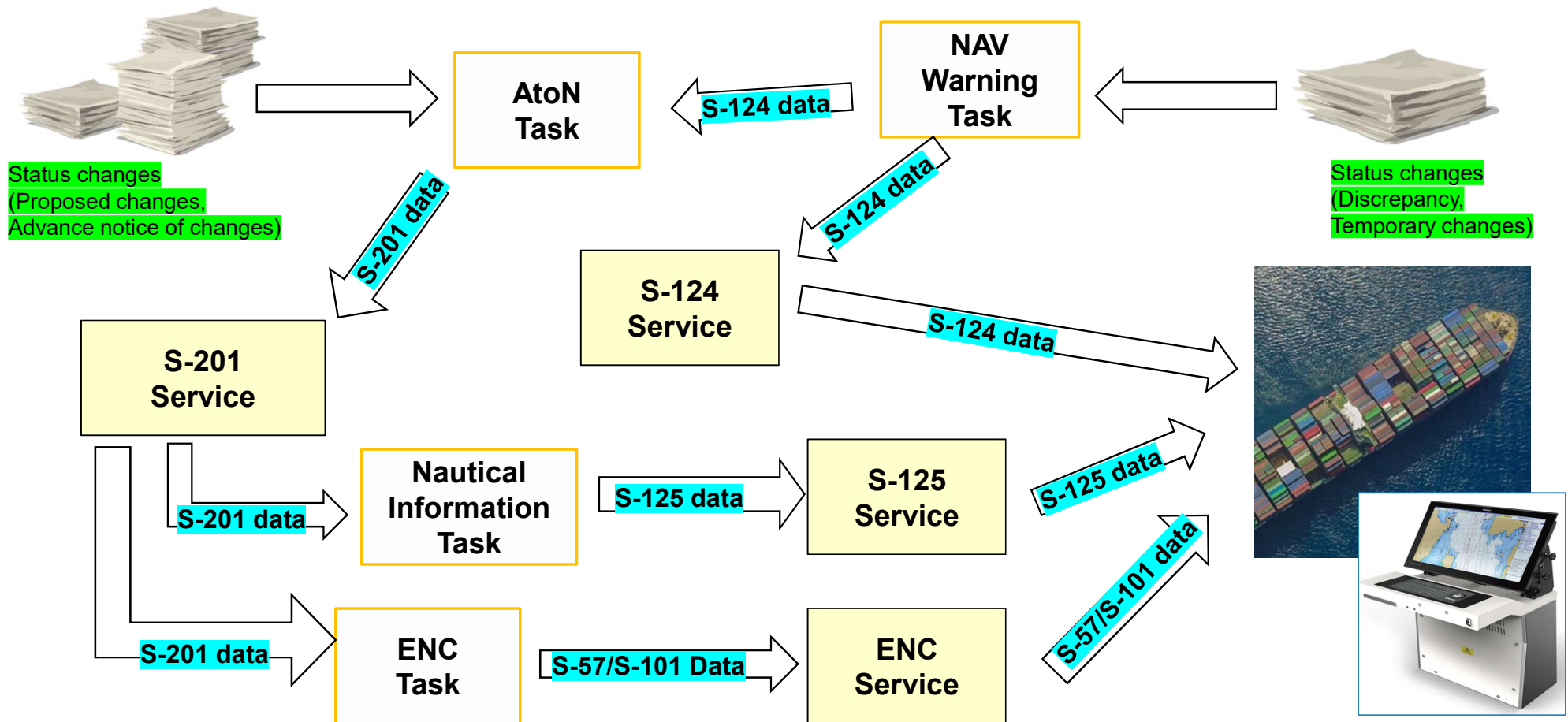
# AtoN Information

## AtoN Information Service Center



# AtoN Information

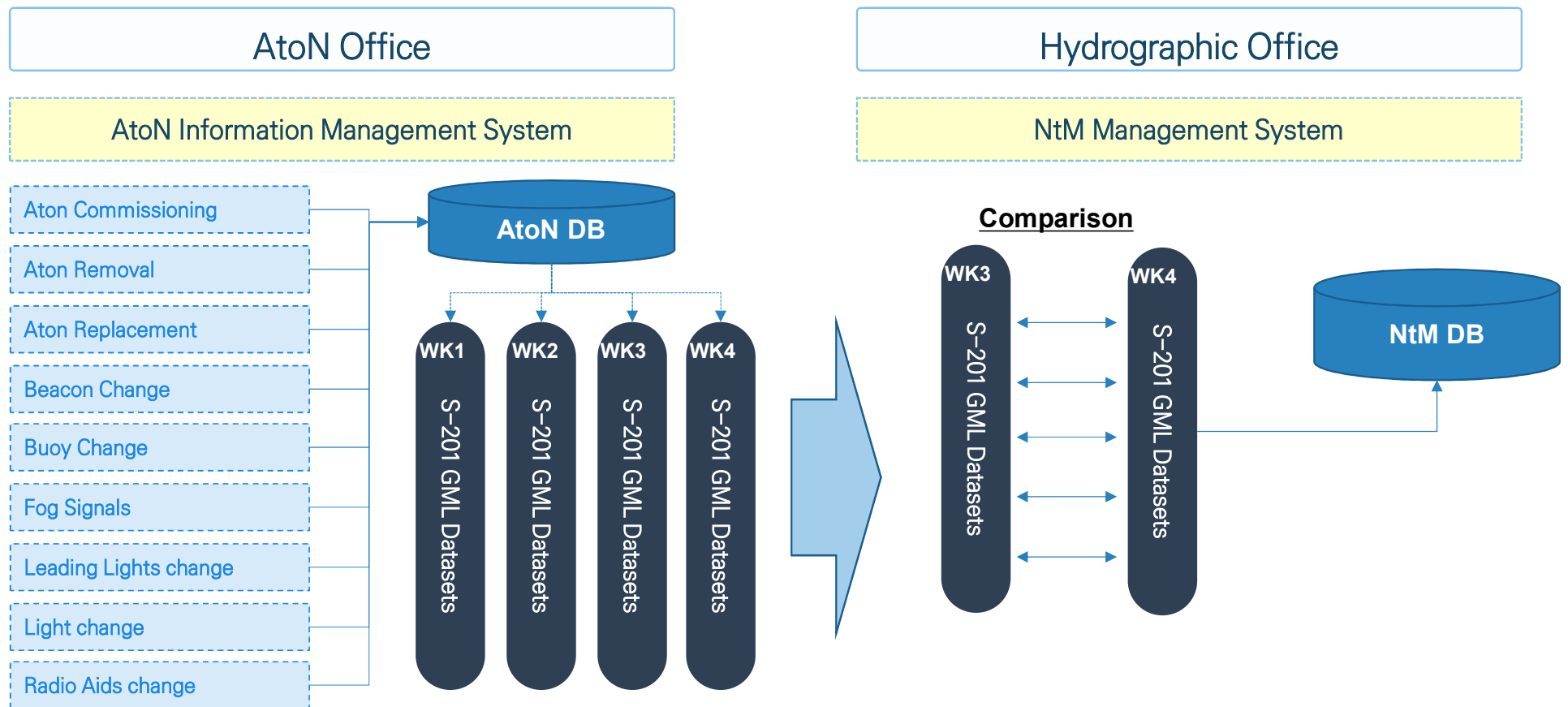
## Data flow of S-201/S-125/S-124



# AtoN Information

## Aton changes service (S-201 Aton Info / S-124 NW / S-125 Marine Aton)

AtoN info. exchange between AtoN Office and Hydro Office



# AtoN Information

## Aton changes service (S-201 Aton Info / S-124 NW / S-125 Marine Aton)

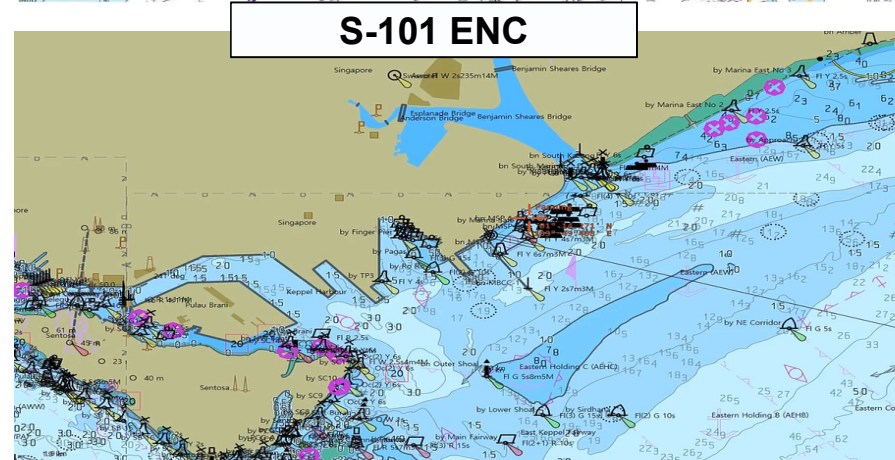
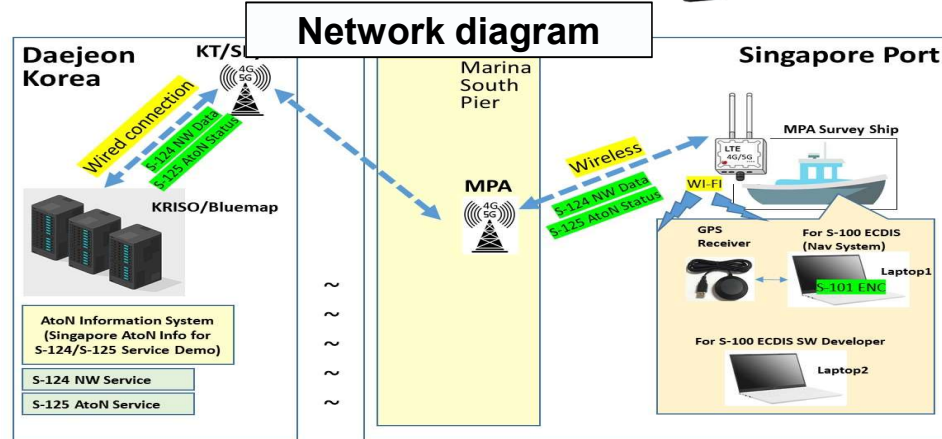
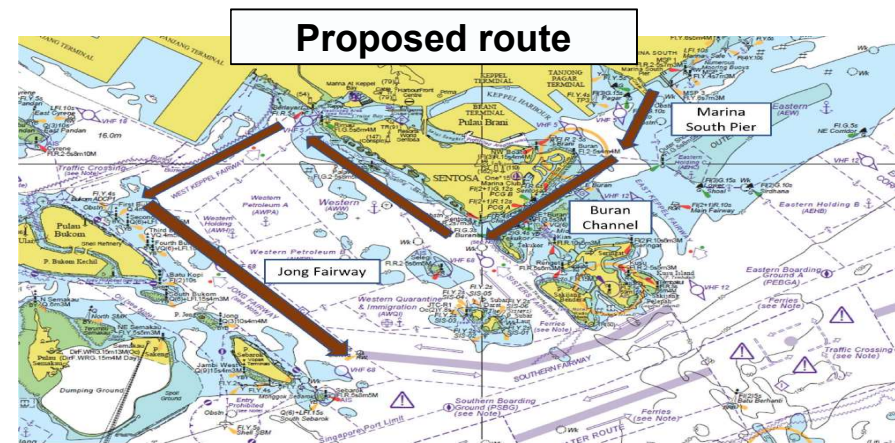
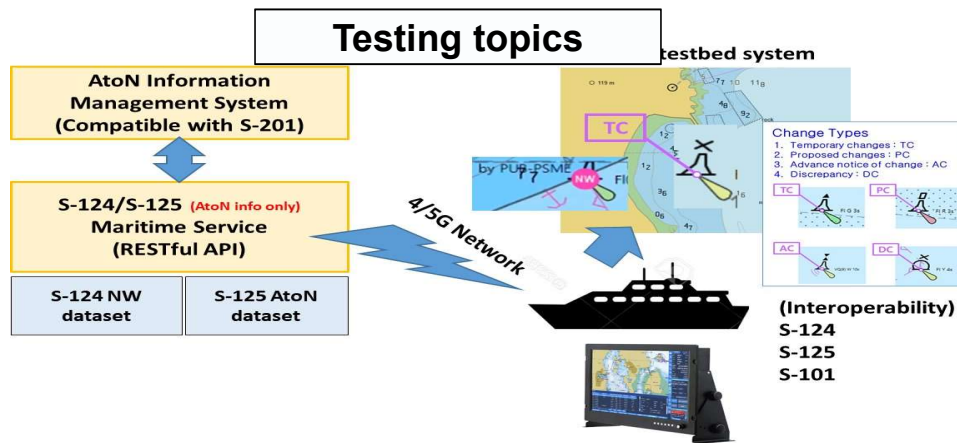
IHO-Singapore Lab

Updated : 9 June 2023

Project No.	Status	Doc. No.	Title	Date
2021-01	Open	<b>S-131 Marine Harbour Infrastructure Database</b>		
		01	Project Proposal_Phase 1( <a href="#">.doc</a> , <a href="#">.pdf</a> )	8Sep2021
		02	Project Proposal_Phase 2( <a href="#">.doc</a> , <a href="#">.pdf</a> )	8Feb2022
2021-02	Open	<b>Conversion from S-57 to S-101 ENC</b>		
		01	Project Proposal_Phase 1( <a href="#">.doc</a> , <a href="#">.pdf</a> )	8Sep2021
		02	Project Proposal_Phase 2( <a href="#">.doc</a> , <a href="#">.pdf</a> )	16Mar2022
2022-03	Open	<b>Demonstrate interoperability of S-101 and S-102 on an S-100 compatible ECS (Revised)</b>		
		01	Project Proposal_Phase 1( <a href="#">.doc</a> , <a href="#">.pdf</a> )	16Mar2022
		02	Project Proposal_Phase 2( <a href="#">.doc</a> , <a href="#">.pdf</a> )_revised	12July2023
2022-04	Open	<b>IHO &amp; IALA collaboration to Demonstrate Interoperability of S-101 and S-125 at Sea</b>		
		01	Project Proposal_Phase 1( <a href="#">.doc</a> , <a href="#">.pdf</a> )	29Nov2022
		02	Project Proposal_Phase 2( <a href="#">.doc</a> , <a href="#">.pdf</a> )	29Nov2022
		03	Result Report( <a href="#">.pdf</a> )	11May2023

# AtoN Information

## Aton changes service (S-201 Aton Info / S-124 NW / S-125 Marine Aton)





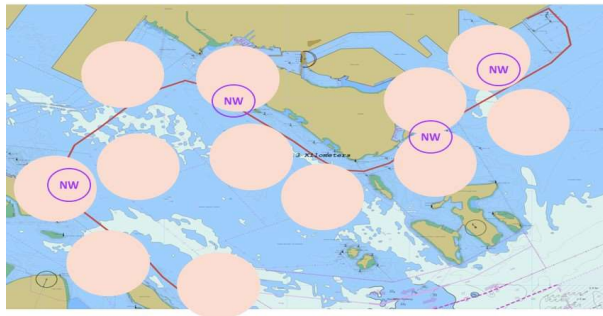
# AtoN Information

## Aton changes service (S-201 Aton Info / S-124 NW / S-125 Marine Aton)

Testing scenarios

### 1. Request and receive S-124 before departure

- 1-1. Receiving test of S-124 dataset in route + buffer
- 1-2. Non-receiving test of S-124 dataset unrelated to route
- 1-3. Receiving test of S-124 dataset where nominal range and route intersect

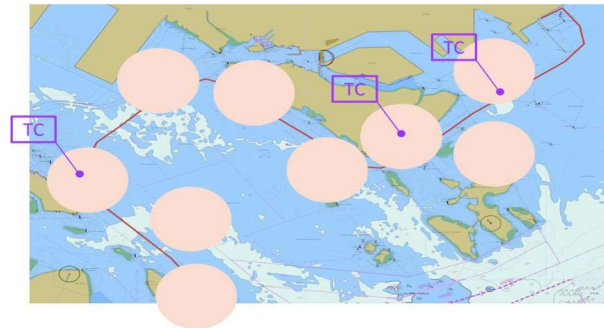


- Before departure, request the S-124 NW service
- Receive the S-124 NW data for the planned route
- Display the S-124 NW Symbol in the user system

Testing scenarios

### 2. Request and receive S-125 before departure

- 2-1. Receiving test of S-125 dataset in route + buffer
- 2-2. Non-receiving test of S-125 dataset unrelated to route

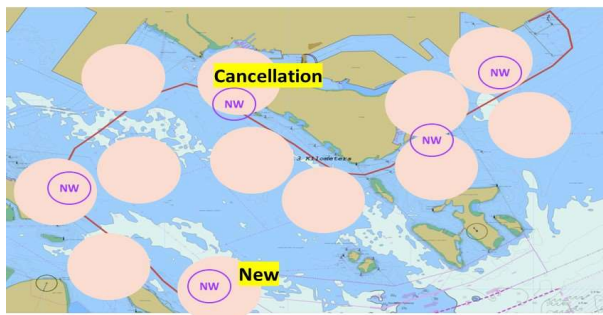


- Before departure, request the S-125 Marine Aton service
- Receive the S-125 Aton changes for the planned route
- Display the S-125 Aton changes Symbol in the user system

Testing scenarios

### 3. Update S-124 while sailing

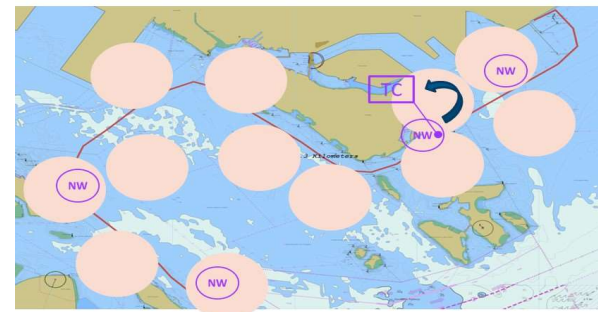
- 3-1. Receiving test of new S-124 dataset in sailing
- 3-2. Receiving test of S-124 cancellation dataset in sailing



- While sailing, request the S-124 NW Service
- Receive the new S-124 NW and canceled S-124 NW
- Display the new S-124 NW Symbol and confirms the canceled NW disappeared in the screen

### 4. Transit from S-124 to S-125 while sailing

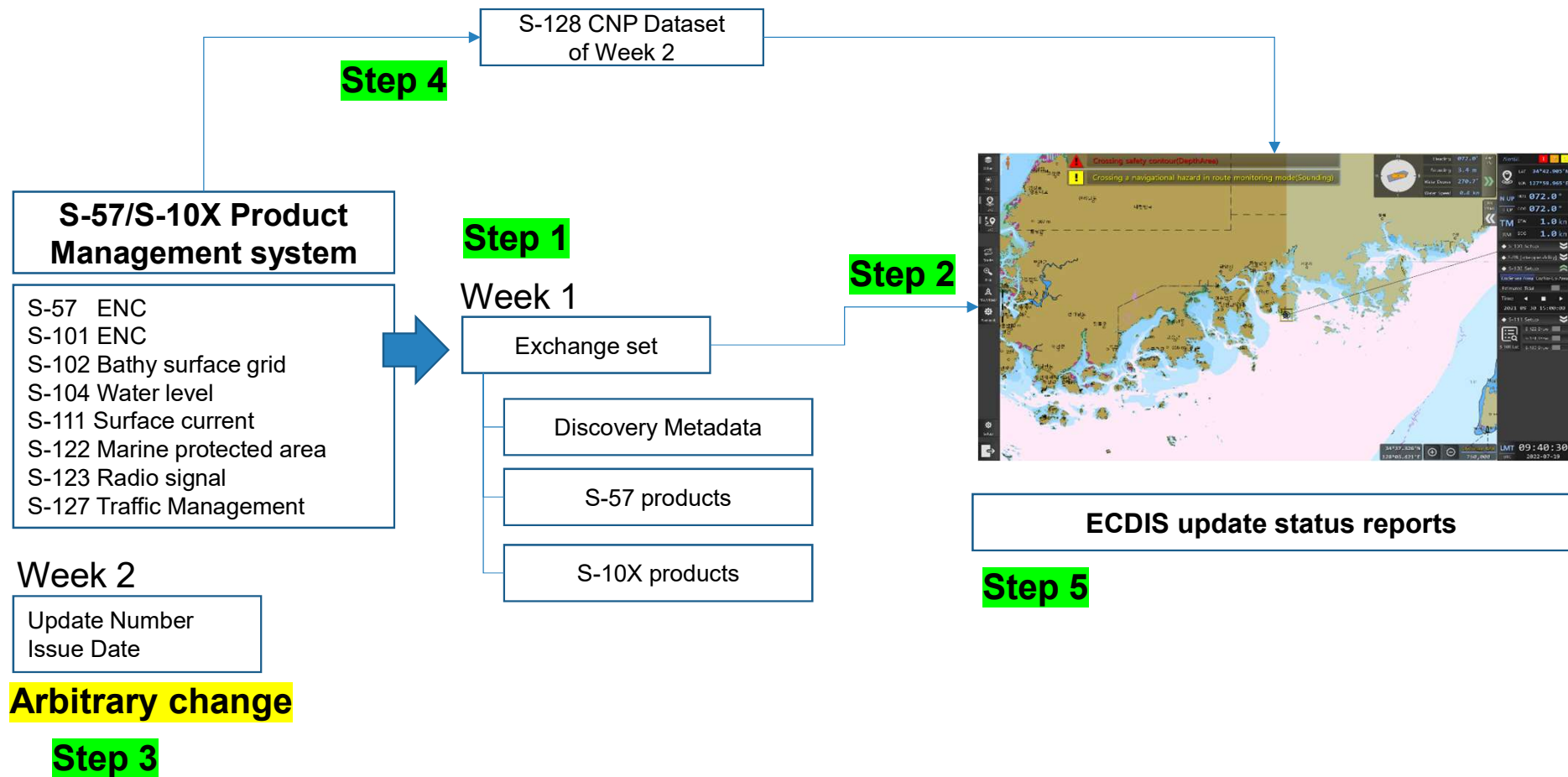
- 4-1. Transition test from S-124 dataset to S-125 dataset in sailing



- While sailing, request the S-124 NW Service and S-125 Marine Aton service
- Receive the S-125 Aton changes and S-124 NW for same Aton
- User confirms that NW symbol changes to Aton change symbol

# S-128 (Catalogue of Nautical Products)

## Up-to-dateness of S-XXX datasets



# S-128 (Catalogue of Nautical Products)

## END(Electronic Navigational Data) manager of S-100 Testbed

[Revised Form]

**Report Name:** Electronic Navigational Charts (ENC) Update Status Report

**Vessel Name:**

**Identifier:**

**Update Reference Date:** (from S-128)

**Date of Report:**

**Content:** Filtered for Route Plan "Goteborg – Kiel"

**Start WP:**

**End WP:**

**Dataset Status Summary**

Data Server: XXXX

Product	Dataset Name	Edition	Update	Issue Date	Status
S-101	101US23495820	10	4	2020-01-02	Up to Date
S-102	102US29348021				

Report(S-128)

Report Name: Electronic Navigational Charts(ENC) Update Status Report

Vessel Name:

Identifier:

Update Reference Date: (from S-128)

Date of Report: 2022-09-12

Content:

Chart Status	Count
Total	462
Up to Date	446/462
Not Up to Date	16/462
Withdrawn	0/462
Unknown	0/462

Dataset Status Summary

Products	Num	Dataset Name	Edition	Update	Issue Date	Status
ALL	1	[S-57] KR1F0000	18	20	20220107	Up to Date
S-57	2	[S-57] KR2F4000	17	6	20220107	Up to Date
S-101	3	[S-57] KR3F4D00	9	0	20220107	Up to Date
S-102	4	[S-57] KR3F4H00	25	2	20220107	Up to Date
S-104	5	[S-57] KR4F4H10	20	5	20220107	Up to Date
S-111	6	[S-57] KR4F4H20	36	2	20220107	Up to Date
S-122	7	[S-57] KR4F4H30	22	21	20220107	Up to Date
S-123	8	[S-57] KR4F4H40	22	13	20220107	Up to Date
S-124	9	[S-57] KR5F4H21	24	2	20220107	Up to Date
S-127	10	[S-57] KR5F4H22	29	4	20220107	Up to Date
	11	[S-57] KR5F4H23	24	4	20220107	Up to Date
	12	[S-57] KR5F4H24	21	2	20220107	Up to Date

Report(S-128) ! Positioning system failure(GPS)

Report Name: Electronic Navigational Charts(ENC) Update Status Report

Vessel Name:

Identifier:

Update Reference Date: (from S-128)

Date of Report: 2022-09-12

Content:

Chart Status	Count
Total	462
Up to Date	446/462
Not Up to Date	16/462
Withdrawn	0/462
Unknown	0/462

Dataset Status Summary

Products	Num	Dataset Name	Edition	Update	Issue Date	Status
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S-101	3	KR3F4D00	9	0	20220107	Up to Date
S-102	4	KR3F4H00	25	2	20220107	Up to Date
S-104	5	KR4F4H10	20	5	20220107	Up to Date
S-111	6	KR4F4H20	36	2	20220107	Up to Date
S-122	7	KR4F4H30	22	21	20220107	Up to Date
S-123	8	KR4F4H40	22	13	20220107	Up to Date
S-124	9	KR5F4H21	24	2	20220107	Up to Date
S-127	10	KR5F4H22	29	4	20220107	Up to Date
	11	KR5F4H23	24	4	20220107	Up to Date
	12	KR5F4H24	21	2	20220107	Up to Date

Report(S-128) ! Positioning system failure(GPS)

Report Name: Electronic Navigational Charts(ENC) Update Status Report

Vessel Name:

Identifier:

Update Reference Date: (from S-128)

Date of Report: 2022-09-12

Content:

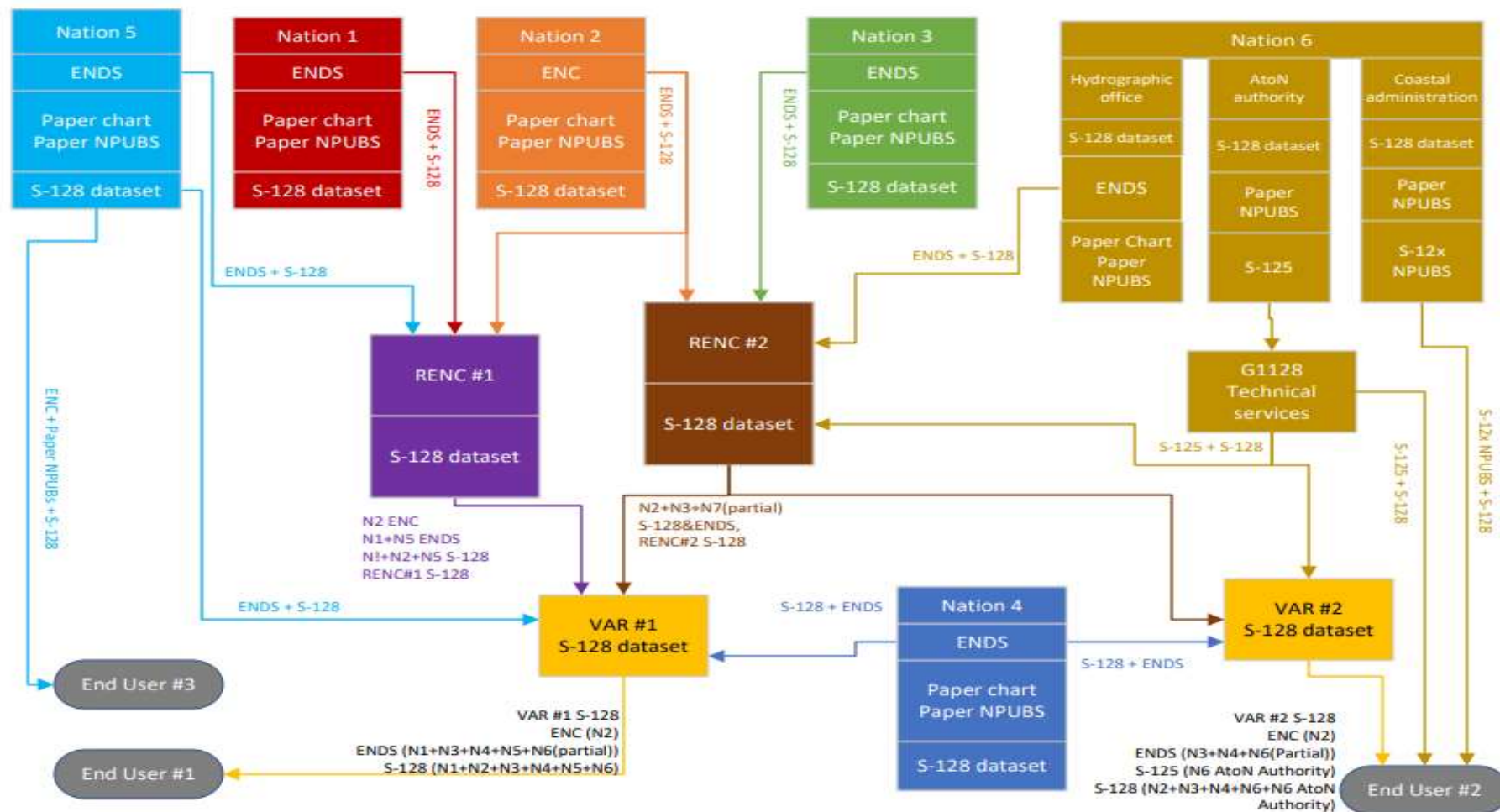
Chart Status	Count
Total	462
Up to Date	446/462
Not Up to Date	16/462
Withdrawn	0/462
Unknown	0/462

Dataset Status Summary

Products	Num	Dataset Name	Edition	Update	Issue Date	Status
ALL	1	101KR00648A24_1	1	1	20220408	Not Up to Date
S-57	2	101KR00648A25_1	1	0	20210129	Up to Date
S-101	3	101KR00648A26_1	1	0	20210129	Up to Date
S-102	4	101KR00648A29_1	1	1	20210629	Up to Date
S-104	5	101KR00648A30_1	1	4	20220408	Up to Date
S-111	6	101KR00648A32_1	1	2	20220408	Up to Date
S-122	7	101KR00648A34_1	1	0	20210129	Not Up to Date
S-123	8	101KR00648A35_1	1	4	20220408	Not Up to Date
S-124	9	101KR00648A36_1	1	0	20210129	Up to Date
S-127	10	101KR00648A38_1	2	3	20220111	Not Up to Date
	11	101KR00648A25_1	1	0	20210129	Up to Date
	12	101KR00648A39_1	2	3	20220408	Not Up to Date

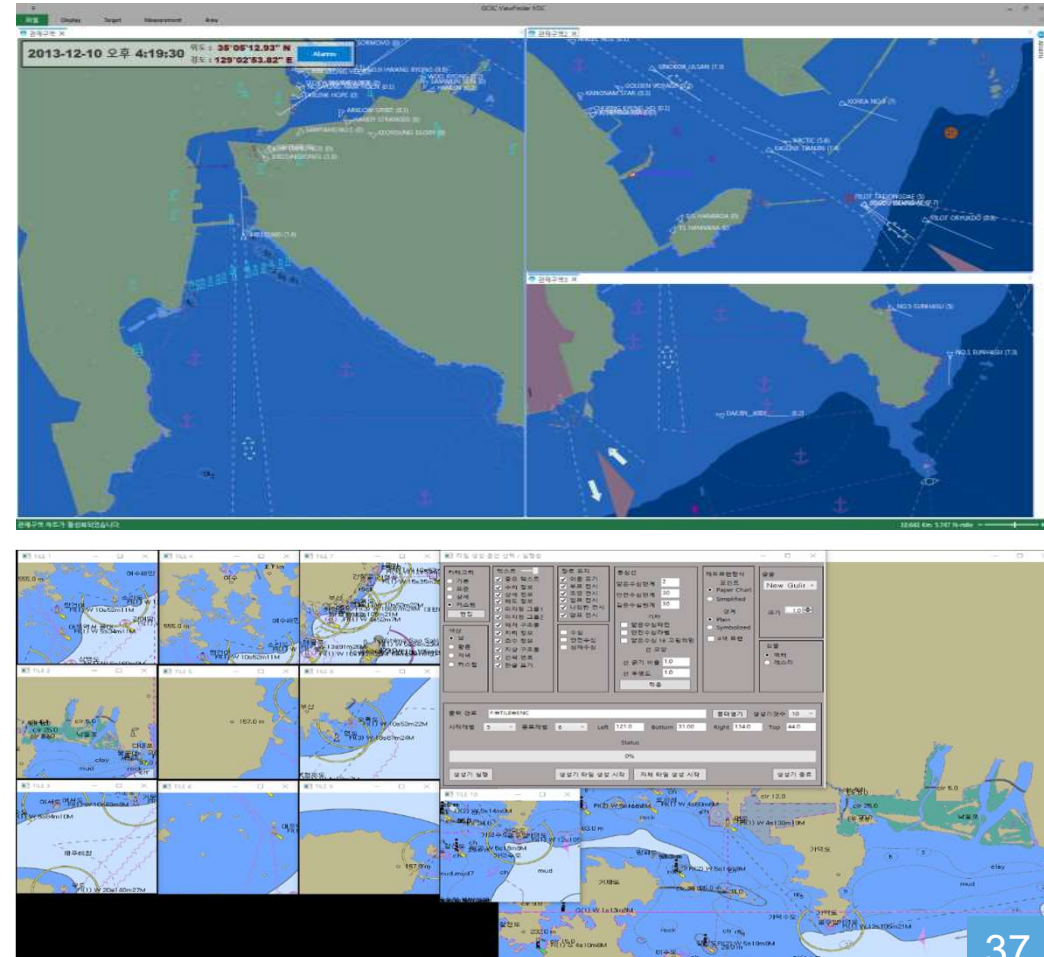
# S-128 (Catalogue of Nautical Products)

## S-128 Service options



# Vessel Traffic Service

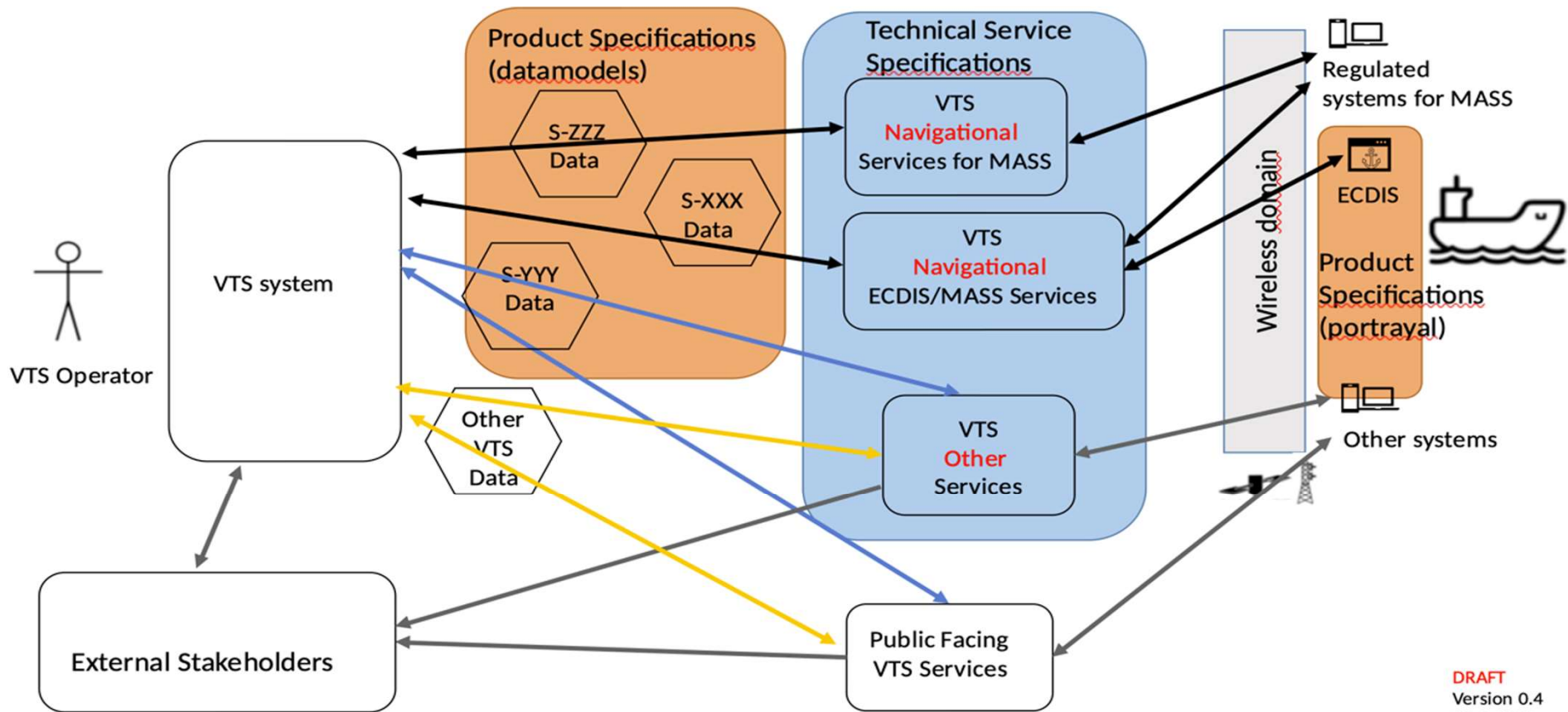
## Cloud VTS and VTS information service



# Vessel Traffic Service

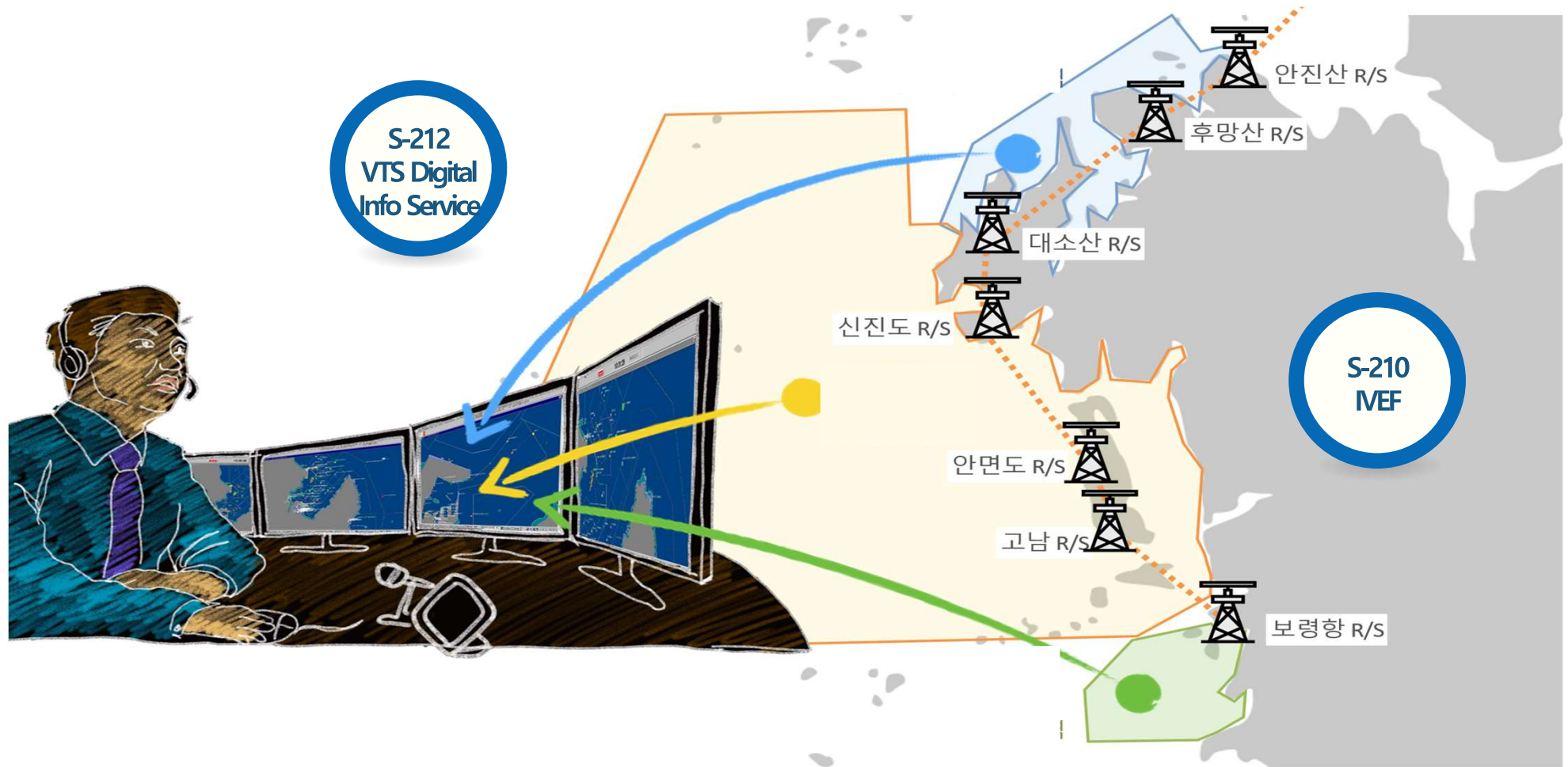
## Cloud VTS and VTS information service

### Digital Delivery of VTS Information



# Vessel Traffic Service

## Cloud VTS and VTS information service



# Vessel Traffic Service

## Cloud VTS and VTS information service

The screenshot displays a VTS interface with a map of the Korean coast. Key elements include:

- Top Bar:** "자율운항지원시스템" (Autonomous Navigation Support System) and "자율운항지원시스템" (Autonomous Navigation Support System).
- Time Display:** KST 2021.12.09 21:58:21, UTC 2021.12.09 12:58:21.
- Ship Detail Panel (Left):**
  - Ship Name: **QUEEN FLOWER**
  - MMSI: 775844335
  - 고속선박 (High-Speed Ship)
  - Location: 129.56896, 35.38009
- Route Detail Panel (Center):**
  - Route ID: **Route6\_20211209**
  - Ship Name: **자6경양호**
  - 생성일: 2021-12-09 21:02:18
  - MMSI: 441811000
  - IMO: 8734200
  - ETA
  - ETD
  - WAYPOINT ID: 8
  - LOC: 129.38089, 35.2875
  - SPEED: kn - kn
- Service Callouts (Right):**
  - S-212 VTS Digital Information Service** (활용)
  - S-421 Route Exchange** (활용)
  - 운항경로 (Operating Route)
  - 기상경보 (Weather Warning)
  - 6중서비스 (6-Service)
- Navigation Buttons (Bottom Right):**
  - 자율운항선박 정보 연계 (Autonomous Navigation Ship Information Link)
  - 항로계획 수신 및 전시 (Route Plan Reception and Display)
  - VTS 정보 교환 (VTS Information Exchange)



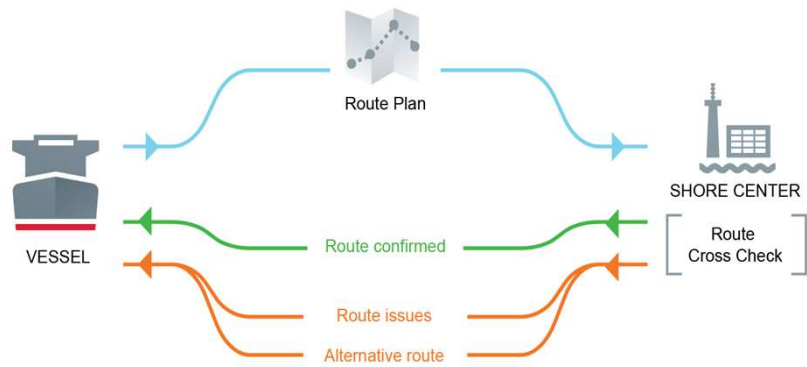
# Maritime Autonomous Surface Ship

Information exchange, Nautical products for MASS

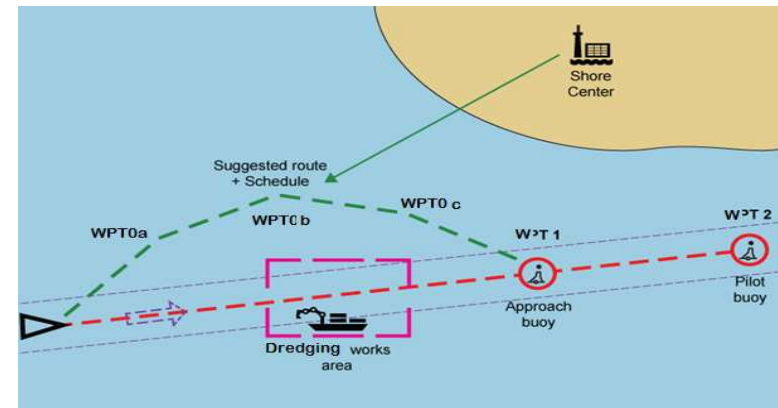


# IEC

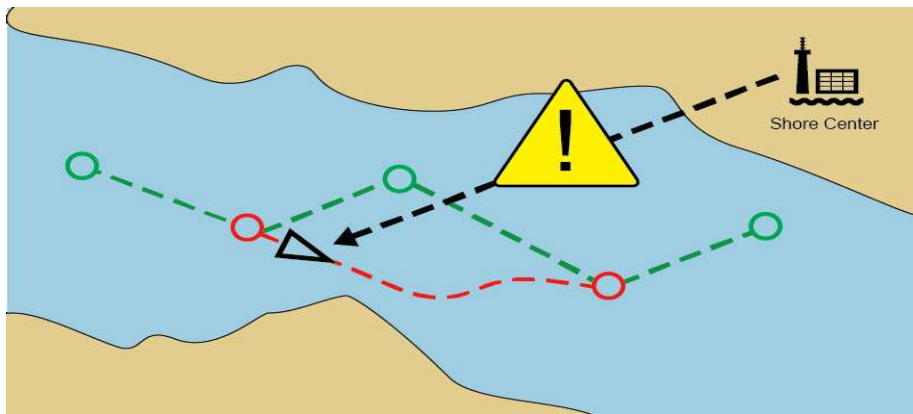
## S-421 Route exchange



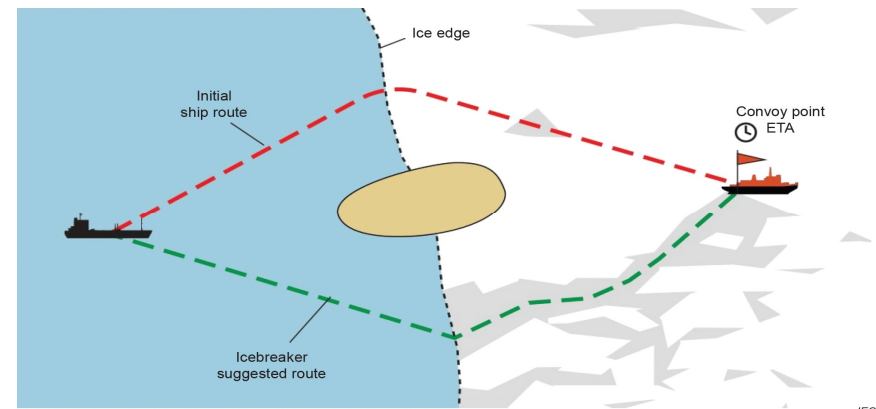
Route Cross Check



Flow Management



Enhanced Monitoring



Ice Navigation

IEC

# Thank you !!!

KRISO / Sewoong OH / [osw@kriso.re.kr](mailto:osw@kriso.re.kr)

