REPORT ON PROOF OF CONCEPT - IHO & IALA COLLABORATION TO DEMONSTRATE INTEROPERABILITY OF S-101 AND S-124/S-125 AT SEA USING WIRELESS UPDATING VIA 4G/5G TELECOMS LINKS AND WORKSHOP, 19TH TO 21ST APRIL 2023 AT THE IHO-SINGAPORE LABORATORY

Background

The joint IALA/IHO workshop on S-100/200 development and portrayal was held in September 2022 at the Norwegian Coastal Administration in Ålesund, Norway.

The joint workshop agreed on the importance of cooperation between the two international organizations on marine digitization, and it was essential to inform the shipping domain of the cooperation efforts between the two bodies. Hence, it was recommended that the relevant working group and task group prepare presentations and demonstrations of S-201 Aids to Navigation (AtoN) Information /S-125 Marine Aids to Navigation /S-124 Navigational Warnings data service.

Specifically on S-125, one of the important outcomes of the workshop was a clear and concise understanding of the purpose and use of S-125 was agreed upon. It was agreed that S-125 would be a suitable replacement for the List of Lights and Fog Signals and act as a bridging mechanism.

It was also agreed that the joint IHO/IALA development of S-125 should continue and the dataset should include, at a minimum, the same Aids to Navigation (AtoN) data contained in the S-101 Product Specification. S-125 should be tested at the earliest opportunity utilizing the services of the IHO-Singapore Innovation and Technology Laboratory (IHO-Singapore Lab)

The Governing Board of the IHO-Singapore Lab at its 4th Meeting agreed in principle and subsequently approved the project proposal between the Korea Research Institute of Ships and Ocean (KRISO) and the Hydrographic Office of the Maritime and Port Authority of Singapore. The project was also supported by the Chair of the IHO Nautical Information Provision Working Group (NIPWG). His role in the project was to design the test scenarios, and to evaluate and gather feedback on the portrayal of the S-124 and S-125 symbology onto the S-101 at the proposed Workshop.

The project was scheduled to be held in conjunction with the Singapore Maritime Week in April 2023 as there would be a wider shipping audience attending the event.

Approved Project Scope

To test the interaction of S-124 and S-125 to better understand its interaction and to validate the proposed development by various groups under the IHO and IALA umbrellas.

The testing was planned for April of 2023 and its aim was to test the feasibility of updating the navigational information services using S-124 and S-125 services, as well as the process of transferring data between these different data services as the information goes through its lifecycles.

## Proposed Project Deliverables

Test results from S-124 and S-125 overlap for the same AtoN on S-101 ENC.

To evaluate that the S-124 should take priority over the S-125.

Operate S-124 and S-125 in S-100 testbed system considering the S-98 Interoperability Specification.

Test results of interoperability between S-124, S-125 and S-101 through interleaving and overlaying which was agreed from the joint IHO/IALA workshop.

Results on suitability of AtoN status symbols in S-125 product specification considering other symbols in ENC, as shown in diagram below, and
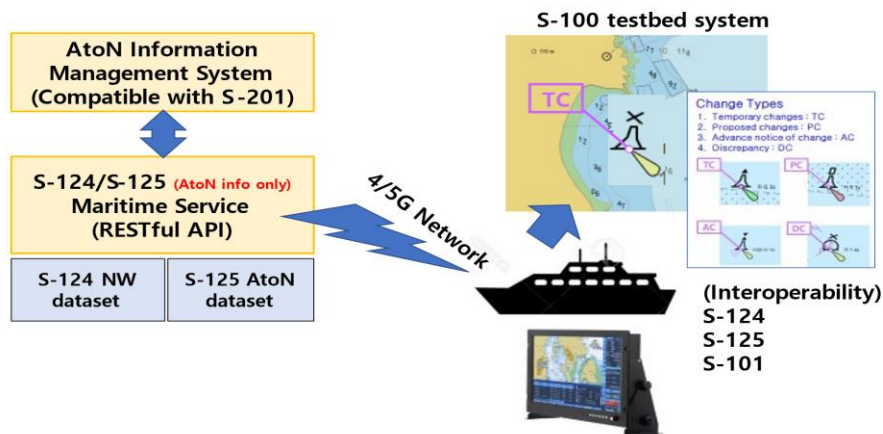
Examples of Proposed S-124/ S-125 Overlays

Test results of technical specifications for the provision of AtoN information service to end-users in terms of e-Navigation maritime service.

Members of Project team

Dr. Sewoong OH, IALA ARM's S-102 Task Group Leader and Principal Research Engineer, Korea Research Institute of Ships and Ocean (KRISO) – Team Leader

Mr. Eivind Mong, Chair, Nautical Information Provision Working Group (NIPWG), IHO, Adviser to Project
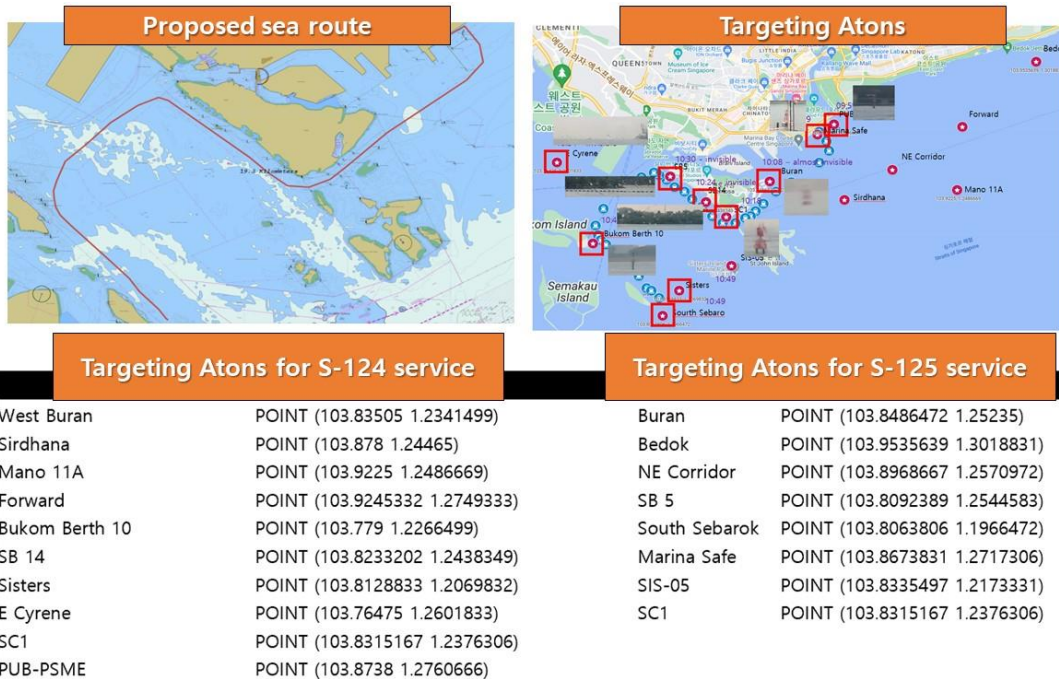
Mr. Lee Weng Choy, Singapore's Maritime Port Authority (MPA)

Aids to Navigation, Cartographic and GeoSpace Sea officers from MPA

Research Scientists from KRISO, Bluemap and SureSoft

Sea Demonstration Route

The Sea demonstration was conducted in the test area within Singapore waters. The route is 19.3km long, departing from Marina South Pier and passing through Buran Channel and Jong Fairway. The route is shown below.

Targeting Atons for S-124 service		Targeting Atons for S-125 service	
West Buran	POINT (103.83505 1.2341499)	Buran	POINT (103.8486472 1.25235)
Sirdhana	POINT (103.878 1.24465)	Bedok	POINT (103.9535639 1.3018831)
Mano 11A	POINT (103.9225 1.2486669)	NE Corridor	POINT (103.8968667 1.2570972)
Forward	POINT (103.9245332 1.2749333)	SB 5	POINT (103.8092389 1.2544583)
Bukom Berth 10	POINT (103.779 1.2266499)	South Sebarok	POINT (103.8063806 1.1966472)
SB 14	POINT (103.8233202 1.2438349)	Marina Safe	POINT (103.8673831 1.2717306)
Sisters	POINT (103.8128833 1.2069832)	SIS-05	POINT (103.8335497 1.2173331)
E Cyrene	POINT (103.76475 1.2601833)	SC1	POINT (103.8315167 1.2376306)
SC1	POINT (103.8315167 1.2376306)		
PUB-PSME	POINT (103.8738 1.2760666)		

Proposed Sea Route and Targeting AtoNs for Demonstration

**Test Configuration for the Sea Demonstration**

When the user requests the service with the ECDIS onboard the vessel in the Singapore Waters via the 4G/5G network service, the service which is installed in Korea will respond with the requested S-124/S-125 dataset. The user then receives the response and then can verify the Navigational Warning or AtoN symbol update according to the service data on the electronic chart screen, as shown in the following test configuration diagram.
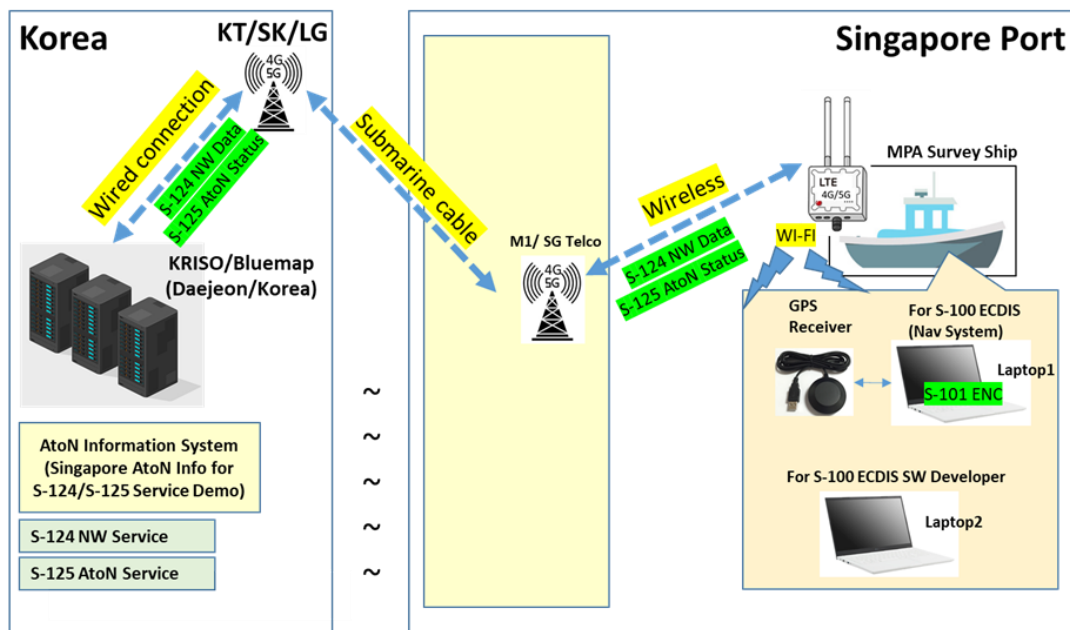
Network diagram and Testing systems used for Demonstration

Summary of Test Scenarios

#	Test Item	Test Date
1	Request and receive S-124 before departure. - Receiving test of S-124 dataset in route + buffer - Non-receiving test of S-124 dataset unrelated to route - Receiving test of S-124 dataset where nominal range and route intersect	20th April, 2023
2	Request and receive S-125 before departure. - Receiving test of S-125 dataset in route + buffer - Non-receiving test of S-125 dataset unrelated to route	20th April, 2023
3	Update S-124 while sailing. - Receiving test of new S-124 dataset in sailing - Receiving test of S-124 cancellation dataset in sailing	20th April, 2023
4	Transit from S-124 to S-125 while sailing. - Transition test from S-124 dataset to S-125 dataset in sailing	20th April, 2023
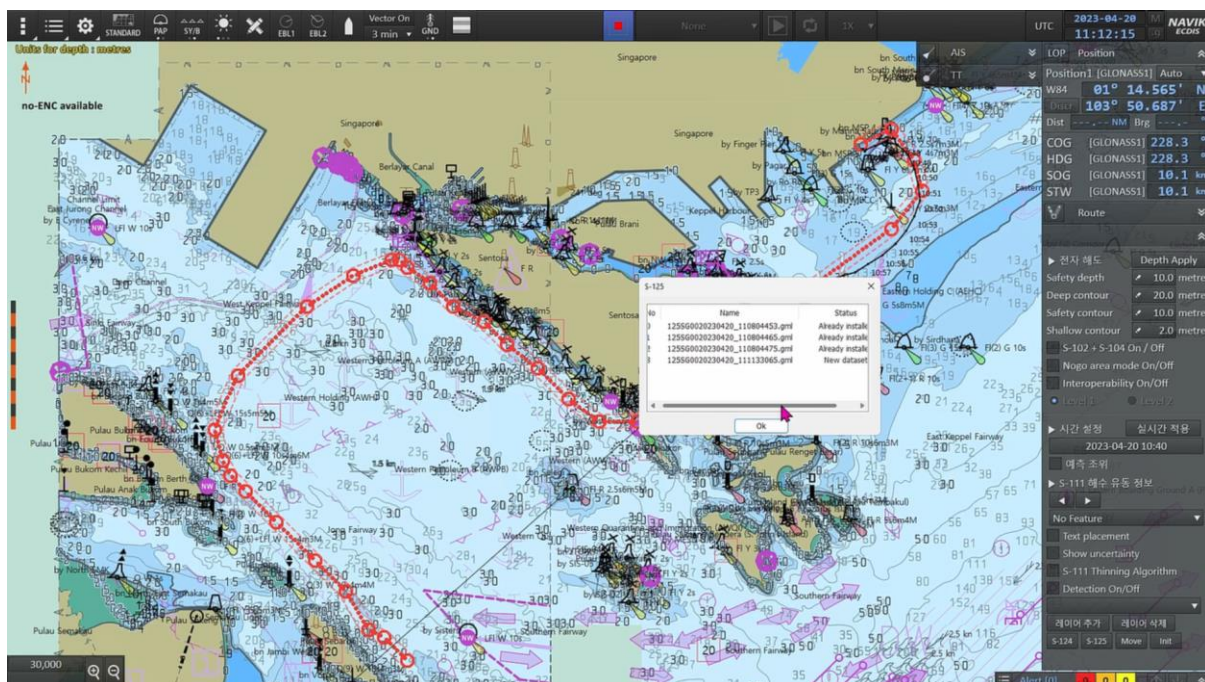
Example of symbols of data registered by ECDIS are displayed on the screen

| Test Scenario | | Dataset list in Information System | | | | | | | |
| | | S-124 | | | | S-125 | | | |
Test Procedure	Expected Result	#	Type	Name of AtoN	Note	#	Type	Name of AtoN	Note
1. Create S-125 data for S-124 cancellation in the AtoN information management system. [Create S-125] - Near route: 1 case 2. Request S-125 service from ECDIS with route + buffer polygon. 3. In the AtoN information management system, Cancel one of the S-124 near the route of the TC-03-002 result. (Create S-124 cancellation data) [Create S-124 cancellation] - Near route: 1 case 4. Request S-124 service from ECDIS with route + buffer polygon.	1. Service transmits data near the route to ECDIS. (Do not transmit out-of-route data) [Service response] - Added 1 case of S-124 cancellation near route to the result of TC-03-002 (8 cases in total) - Added 1 case of S-125 near route to the result of TC-02-002 (5 cases in total) 2. List and S-125 state flag of data registered by ECDIS are displayed on the screen. (Symbols of S-124 and S-125 are overlapped on same AtoN) 3. List and symbols of data excluding data canceled by ECDIS are displayed on the screen.	1	relevant	PUB-PSME	Symbols are displayed on ecdis screen	1	relevant	Buran	Symbols are displayed on ecdis screen
		2		West Buran		2		SB 5	
		3		Bukom Berth 10		3		South Sebarok	
		4		E Cyrene		4		Marina Safe	
		5		SB 14		5		SC1	
		6		NEA-WRM-MP		6	irrelevant	Bedok	Symbols are not displayed on ecdis screen
		7		*Sisters*	Symbol is removed on ECDIS screen according to S-124 cancellation data	7		NE Corridor	
		8		*SC1*		8		SIS-05	
		9	cancellation (relevant)	Sisters	cancel #6				
		10		SC1	cancel #7				
		11	irrelevant	*Forward*	Symbol is removed on ECDIS screen according to S-124 cancellation data				
		12		Sirdhana	Symbols are not displayed on ecdis screen				
		13		Mano 11A					
		14	cancellation (irrelevant)	Forward	cancel #10				
		Total S-124 dataset		14 cases		**Total S-125 dataset**		8 cases	
		relevant S-124 dataset		6 cases		**relevant S-125 dataset**		5 cases	
		relevant S-124 cancellation dataset		2 cases					

Final List of S-124 and S-125 service data

Activities onboard MPA's vessel "Panduan"

Conclusion and Key Takeaways

The Proof of Concept Sea Demonstration tested the feasibility of updating the navigational information services using S-124 and 125 services. It also tested the process of transferring data between these different data services as the information goes through its lifecycles successfully. The key takeaways are from the Sea Demonstration and Focused Group Workshop were:

Sea Demonstration

a.   The project would provide the AtoN authorities a chance to own their datasets (i.e. S-125), rather than rely on Hydrographic Offices (HOs).

b.   Authorities need to consider developing a central S-201 database to support updating service and have it operationalised before January 2026.

c.   The protocols for sequencing and priority to send and display S-124 and S-125 needs to be further examined using Marine Resource Names for AtoN unique identity.

d.   The project also demonstrated a low barrier to entry. System requires only a simple cellular network connection for a wide spectrum of users onboard to adopt and benefit from these services.

e.   During the sea demonstration, deviations had to be made between the planned route and actual route. As a result, it was interesting to discover the effects of the display when the AtoN information relevant to the route fell outside the pre-set buffer. The protocols for setting such buffer needs to be further examined, for example whether the S-124/S-125 information should be guided by Nominal Range of the AtoN, or simply specific to a passage plan.

Outcome from Focused Group Workshop

f.   Mr Eivind Mong, Chair of NIPWG led the discussion on proposed usage of new symbologies, for example use of magenta, translucence, boxes, shading, shapes etc.

g.   The dialogue with shore-based personnel (Mariners, AtoN authority, Cartographers, Hydrographic Surveyors, Port Systems) provided significant value in terms of their different perspectives on the pros and cons for different forms of portrayal of the S-124/S-124 overlays onto S-101.

h.   There is a need to support non-ECDIS systems and users, such as PPUs and ECS used by pilots and other users.

i.   The project serves as an opportunity to kickstart dialogues between AtoN authorities and HOs to align respective responsibilities.

Focused Group Workshop

The preliminary results were presented at the MPA-IALA ENAV-VTS Workshop held at the MPA Academy on 25th April 2023. As the Project was approved at the IHO-IALA Workshop in Norway, the final Project Report will be submitted to the relevant Committees of the IHO, IALA and Governing Board of the IHO-Singapore Lab.

This collaborative project has provided a great opportunity to raise awareness of the value of the IHO-Singapore Lab in facilitating innovation works jointly embarked by the IHO and IALA. The IHO-Singapore Lab looks forward to more opportunities to i) facilitate the conduct of innovative or investigative projects, ii) enable knowledge creation and foster collaboration to evaluate specifications of global standard setting, and iii) foster a multidisciplinary and collaborative environment for investigators.

The **detailed Technical Project Reports** are shown in attached **Annexes**.

Submitted by Joint Project Team

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