Report on Australia's S-124 Testbed

Submitted by Australian Maritime Safety Authority (AMSA)

SUMMARY

Executive Summary: This report presents an overview of AMSA's S-124 testbed, which is part of AMSA's VHF Data Exchange System (VDES) trials. It discusses the implementation of a process for the production and provision of S-124 data, based on input data in the text-based S-53 format. The purpose of this document is to inform about possible strategies to trial S-124 production and provision.

Action to be taken: see paragraph 26

Related documents: IHO S-53, IHO S-124

Introduction

1. The terms of reference of the WWNWS include the need to study and propose new methods to enhance the provision of Maritime Safety Information (MSI) to mariners at sea.
2. As discussed at earlier meetings of the WWNWS, IHO's S-124 standard will deliver the next-generation data product specification for the distribution of navigational warnings.
3. Further, as part of IMO's e-Navigation strategy a Maritime Service for the provision of Maritime Safety Information (MS5) is defined in IMO MSC.1/Circ.1610 ("Initial Descriptions of Maritime Services in the Context of e-Navigation"). This service includes the provision of navigational warnings to mariners.
4. To complement the existing text-based services (such as SafetyNET) AMSA envisions providing navigational warnings in the S-124 format that can directly be integrated into on-board information systems (including ECDIS) and can also support (semi-)automated/autonomous navigation systems through machine-readability. The direct visualisation of the data on an ECDIS will also support the decision-making onboard and can significantly improve situational awareness.
5. AMSA is currently conducting trials to test such a service and analyse how existing processes might be adapted for the production of S-124 data sets as part of their digitalisation strategy.
6. This report gives an overview of the testbed activities and presents preliminary results of testing the exchange of S-124 via the VHF Data Exchange System (VDES).

Testbed activities

7. In 2022, AMSA established a pilot project with the goal of demonstrating selected digital maritime services relevant to maritime authority operations in Australian waters, along with assessing the suitability of the VDES.

8. In the first stage of the project, VDES equipment for receiving S-124 data sets was installed onboard two ships and a prototypical service for the provision of S-124 data was developed.
9. The utilised hardware includes the Saab R6 Supreme AIS/VDES transponder, the Sternula MMS Gateway and the necessary VHF and GNSS antennas. This hardware was used to communicate via VDE-SAT with the Sternula-1 VDES satellite.

Figure 1: Installation of the VDES hardware that is used to receive S-124 data onboard ships.

S-124 Production and Provision

10. Figure 2 shows the overall process required to test the production and provision of S-124 data. The first step is to export data from an existing information system (AMSA's Nexus system) that manages navigational warnings information. This data is used to extract the required information to generate the S-124 data sets. It is then signed digitally and embedded in the standardised S-100 exchange format. After compression, it is sent to a service that handles the transmission to vessels.

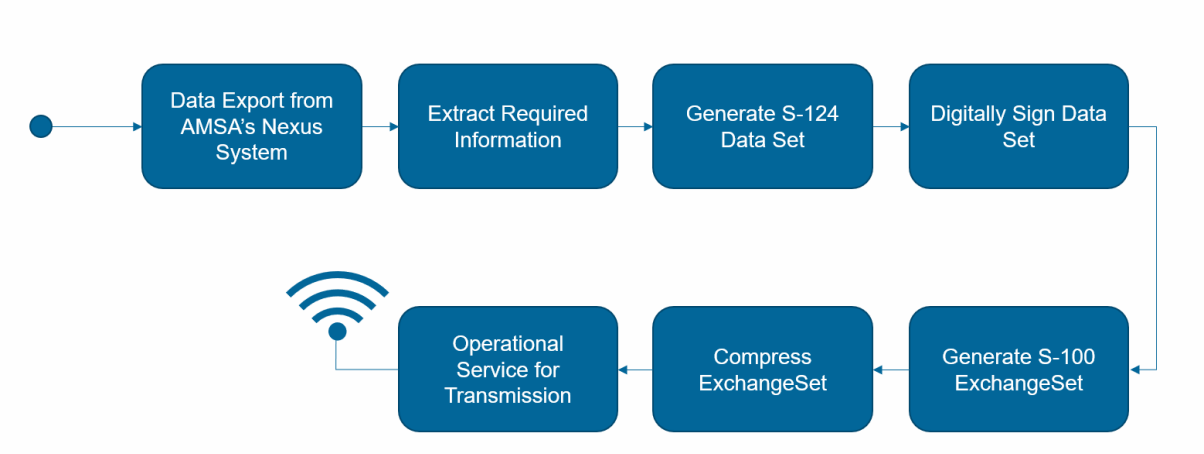

Figure 2: Overview of the Production and Provision Process of S-124

Information Extraction

11. Figure 3 shows an example of a text-based navigational warning message as it is currently used. All the necessary information for the mariner is encoded as text in a human-readable format only. This format does not support machine-readability or direct portrayal, or only to a very limited extent.

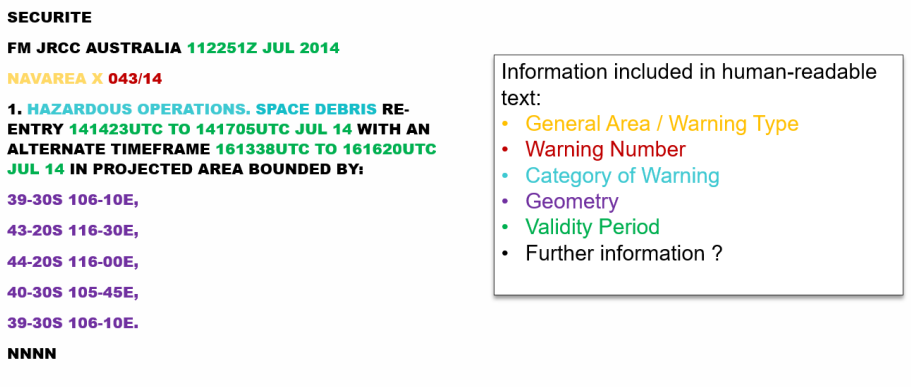

Figure 3: Example of the included information in a text-based navigational warning.

12. Although the best solution would be to update existing information systems to support the production of S-124 data, this might not be feasible for trial projects, as it requires significant modification of safety-critical business processes.
13. Therefore, to extract the necessary data from the text-based messages, a combination of rule-based text parsing and AI-assisted parsing (by utilising a Large Language Model (LLM)) was utilised. These methods do not deliver 100% accuracy in extracting necessary information such as the category of the navigational warning or its geographical extent and still need human supervision. However, this machine-assisted approach can still be helpful in an operational setup to increase the efficiency of the (human-supervised) data production process or in training courses for operators.

Data Set Generation

14. With the necessary information extracted in a structured data format, the official S-124 data schemas were used to generate instances of S-124 data sets and serialise them in the standardised S-100 GML-format. This process was automated and can be triggered by an Application Programming Interface (API) for future integration with existing information systems.
15. As the data generation was only part of a trial, advanced capabilities of the S-124 standard, such as data set referencing, cancellation of data sets or the support of multiple languages were left to be implemented in future projects to operationalise the production and provision of S-124 data sets.
16. As per S-124 Product Specification, S-124 data must be exchanged in an “S-100 ExchangeSet”, which is a special format that includes metadata and digital signatures. This was the next step in the data generation.
17. Digital signatures are one of the main advantages of S-124 data sets, as they enable the end-user to validate the authenticity of navigational warning information. This is not possible when using, e.g., NAVTEX and therefore S-124 significantly enhances cyber security for the provision of navigational warnings.
18. Finally, the signed ExchangeSet was compressed and sent to the service that transmits the data.

Service for Transmission

19. It should be noted that the data set production is only one step in the provision of next-generation navigational warnings. In contrast to the means of distribution of (legacy) S-57 charts (via CDs, flash drives or manual downloads), the provision of S-100 data is much more service-oriented, and the data can directly be integrated into ECDISs. This approach enables real-time and secure data exchange and immediate portrayal of data products. Figure 4 shows the three relevant types of specification and their references: S-100 based data models, the technical services, and the operational guidance from IMO. All three specification levels (IMO MS5 definition, NW technical service specification, S-124 data model) must be considered for the implementation of a S-124 based service.

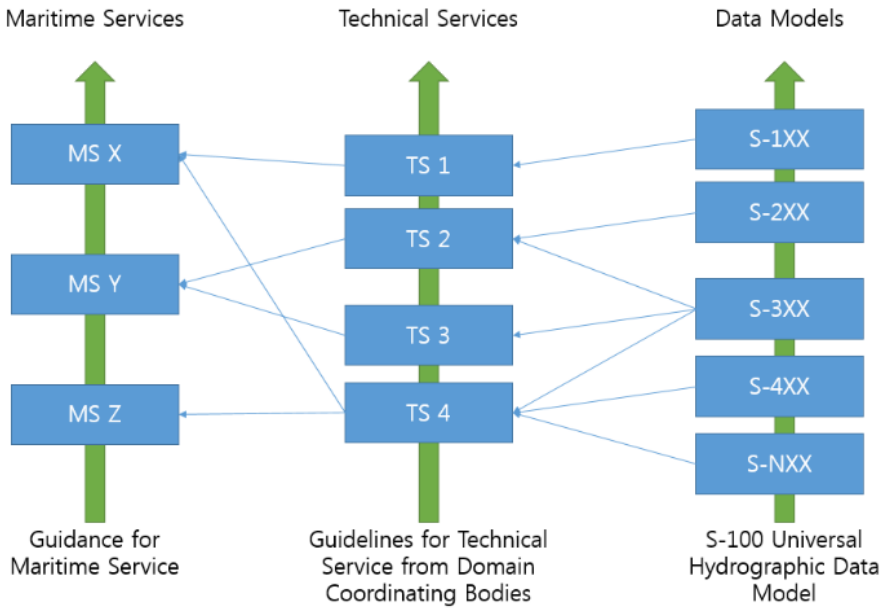

Figure 4: Excerpt from IMO MSC.467(101) - GUIDANCE ON THE DEFINITION AND HARMONIZATION OF THE FORMAT AND STRUCTURE OF MARITIME SERVICES IN THE CONTEXT OF E-NAVIGATION

20. AMSA is participating in an international WG ("Open Digital Incubator Initiative") that progresses the specification and implementation of a technical navigational warnings service. This group is also supported by the Chair of the S-124 PT.
21. It is planned to utilise the Maritime Connectivity Platform (MCP) as well as the IEC 63173-2 Maritime navigation and radiocommunication equipment and systems - Data interfaces - Part 2: Secure communication between ship and shore (SECOM) to implement an operational service in the future.

Preliminary results of the trials

22. In July, AMSA was able to generate the first S-124 test data sets from real source data issued by the AMSA JRCC, following the process presented in Figure 2. In the tests, a single navigational warning (including ExchangeSet metadata, compressed) had a size of 4kb on average. According to ITU M.2092, the maximum recommended VDE-SAT payload size is 10kb, however, it is expected that the transmission of larger chunks of data is possible in the future.

23. Keeping in mind that services like the Maritime Connectivity Platform's Maritime Message Service (MCP MMS) can intelligently determine whether to use VDE-TER, VDE-SAT or IP-based communication channels, it will be possible to implement S-124 services in such a way that a ship can query a list of all in-force warnings of a specified area via VDE-TER or IP at the beginning of her voyage (or whenever connectivity is available) and then receive real-time updates via VDE-SAT. With a global constellation of VDES satellites, it could also be possible to provide the entire service via VDE-SAT (sending multiple in-force warnings in multiple messages on request or scheduled).
24. For the sake of demonstration, AMSA implemented an internal web-based UI, to visualise S-124 live data for Australia as shown in Figures Figure 5, Figure 6, and Figure 7. Please note that this was only used for demonstration purposes and does not fully comply with S-124 portrayal rules.
25. AMSA is planning to start testing the transmission of S-124 via VDE-SAT internally, shortly after the WWNWS15 and will provide an update at the next Sub-Committee meeting.

Action to be taken

26. The Sub-Committee is invited to note the information provided.

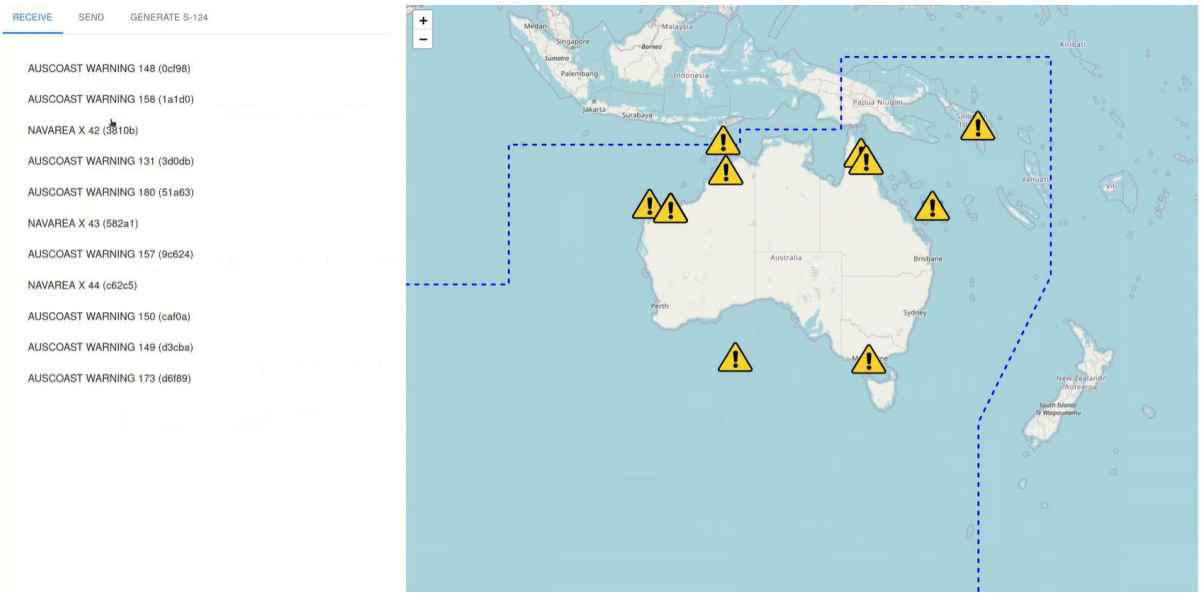

Figure 5: Demonstrator UI for AMSA's test S-124 data sets: In-force warnings overview.

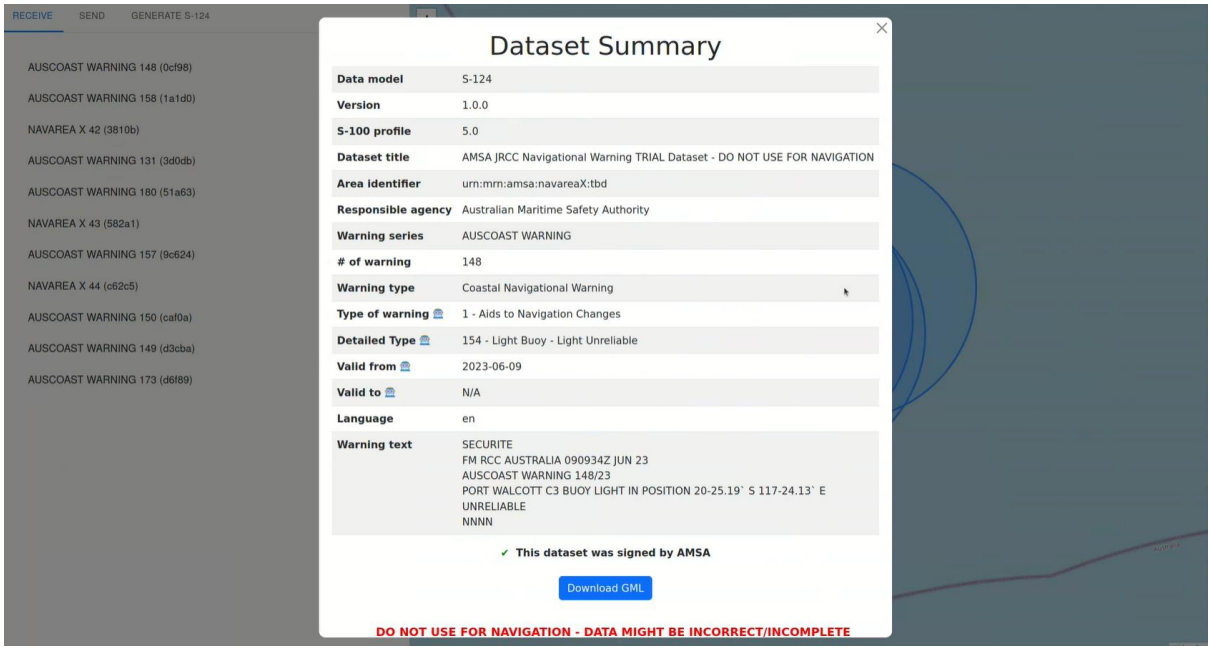

Figure 6: Demonstrator UI for AMSA's test S-124 data sets: Data set details view.

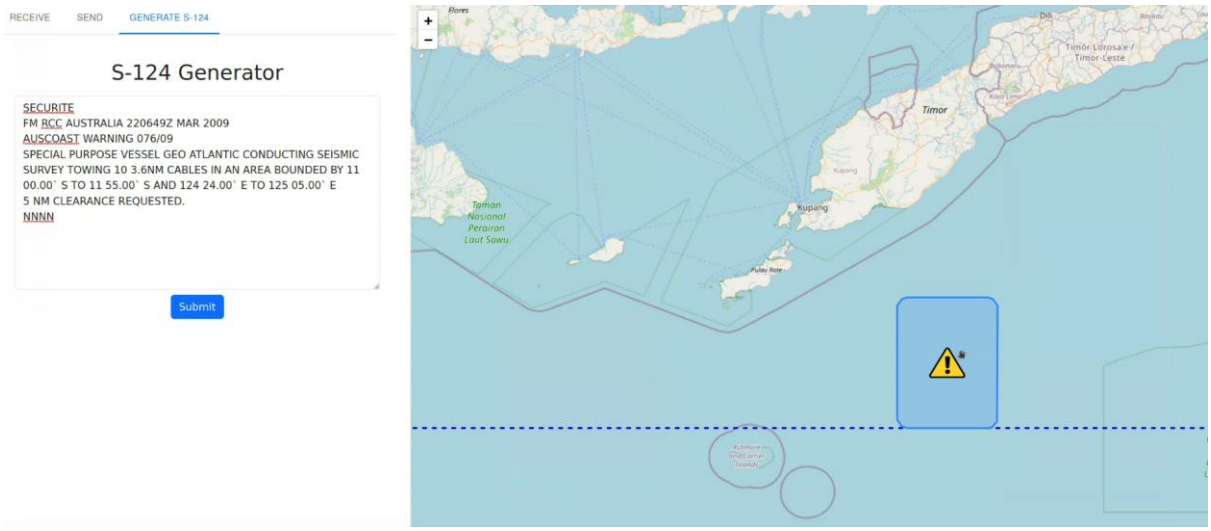

Figure 7: Demonstrator UI for AMSA's test S-124 data sets: Generation from text-based warnings.