

The Connection between S-124 Navigational Warnings and S-125 Marine Aids to Navigation (AtoN)

Eivind MONG

Canadian Coast Guard, Marine Navigation Programs
Chair IHO Nautical Information Provision Working Group
Chair IHO S-124 Navigational Warning Project Team
Burlington, ON CANADA
Eivind.Mong@dfo-mpo.gc.ca

ABSTRACT (ENGLISH)

S-124 is an S-100-based format for issuing Navigational Warnings in compliance with IHO S-53/IMO MSC.1/Circ.1310 as amended. S-124 is currently under development by the World Wide Navigational Warning Service Sub-committee (WWNWS-Sc) which is being led by the Canadian Coast Guard. S-125 can be described as an advanced digital list of Aids to Navigation (AtoN). IALA is drafting S-125 Product Specification and Technical Service Specification on behalf of IHO's Nautical Information Provision Working Group (NIPWG), as a means to communicate status of AtoN systems, including outages and prior notice of changes to AtoN systems. This paper will explore the envisioned operational interaction between S-124 and S-125 in shore-side and ship-board systems. This paper will explain the status of S-124 and S-125 developments, their intended use individually, and how information could transition from the S-124 data stream into the S-125 data stream. The paper will also explore how this interaction between S-124 and S-125 can help safe navigation, including autonomous navigation (MASS).

KEYWORDS: Navigational Warnings, NAVWARN, S-100, S-124, S-125, Aids to Navigation, AtoN, MASS

1 INTRODUCTION

S-124 [1] is an S-100-based [2] format for issuing Navigational Warnings in compliance with IHO S-53/IMO MSC.1/Circ.1310 as amended [3]. S-124 is currently under development by the World Wide Navigational Warning Service Sub-committee (WWNWS-Sc) and the work is led by the Canadian Coast Guard. S-125 [4] can be described as an advanced digital list of Aids to Navigation (AtoN). IALA's ARM Committee is drafting S-125 Product Specification and Technical Service Specification on behalf of IHO's Nautical Information Provision Working Group (NIPWG), as a means to communicate status of AtoN systems, including outages and prior notice of changes to AtoN systems.

S-124 and S-125 must be implemented in harmony for the benefit of the end user, since both can carry similar information about the same events. An added challenge is that the ENC (S-57 [5] or S-101 [6]) also contains AtoN information, with ENCs being the primary source of AtoN information in the ECDIS for over 20 years. These topical and content overlaps necessitate a clear rule set for how the three products will operate in a user system.

The IALA/IHO S-100/S-200 workshop [7] in Norway in September 2022 provided a venue for cross organizational discussion on how the IHO needs could be harmonized with those of IALA. The workshop recommended that S-125 be developed for ECDIS use, but only portraying the status updates of AtoN systems by including rules in the IHO S-98 Interoperability Catalogue that, by default, mask all AtoN information from S-125, except for the status updates. NIPWG, at its 9th meeting, picked up these recommendations [8] as a

basis for the continued S-125 development framework and encouraged IALA ARM Committee to adopt it as well.

2 ENVISIONED OPERATIONAL INTERACTION

With the S-125 development framework that NIPWG has defined and with IALA's ARM committee adoption of the draft 0.0.3 release of S-125 its 16th meeting in October 2022, there are some considerations that need to be made when planning for operational use of S-125. First and foremost, will be to determine who should create the service that issues S-125 datasets. This will be a national decision including whether there will be S-125 in national waters. Regardless, there still need to be a set of common rules so that user systems can be ready for S-125 services.

The national authority historically has issued the List of Lights publication and this authority would be the primary candidate for any S-125 service. However, consideration should also be given as to which competent organization has historically been responsible for AtoN information, since this is the source of all S-125 datasets; consideration could also be given to which competent organization has historically been responsible for Notice to Mariners, since this is also a source of temporary and preliminary information related to AtoNs. A further consideration is the competent organization responsible for navigational warnings: this service is a significant conduit for short term AtoN information communicated to users, including information about outages and missing or damaged AtoNs. As noted, any organization involved with one or more of these tasks could be a candidate for an S-125 service operator. No matter which option is chosen, there is a strong need for good information exchange between the different entities to ensure the efficient flow of information so that the end user is not confused by having the same information through many sources.

The IALA/IHO S-100/S-200 workshop concluded that it would not be possible to give a general recommendation of which organization should do the work, but rather developed an information flow diagram to show the relationship between the tasks and services as a guide for anyone wishing to set up a S-125 service. This diagram is included below as Figure 1.

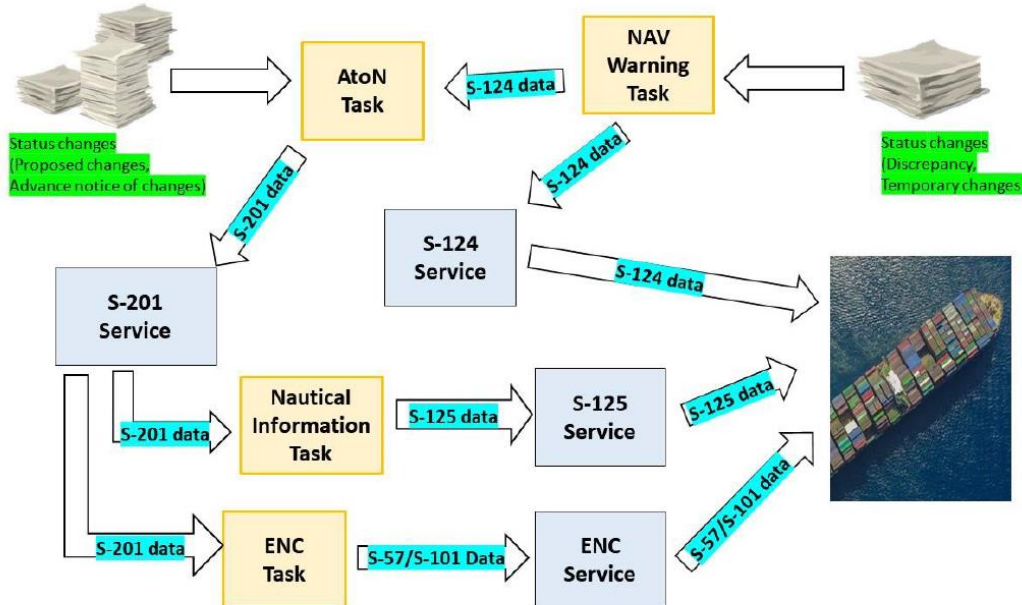


Figure 1 - AtoN information flow

The flow diagram shows that the two general inputs expected is through proposed changes at the AtoN service and by reported discrepancies or temporary changes via the navigational warning (NAVWARN) service. Both can serve as source material for S-125 datasets. At this point it is worth noting that although the information received via the navigational warning task will already have reached the end user, the S-124 format does not permit visualization of AtoN information in ways that differ from any other NAVWARN information, meaning the end user must still read and mentally digest the information before deciding how relevant it is for the situation the end user is facing. S-125 on the other hand, will have visualization that permits the specific portrayal of status changes to an AtoN based on the information from either the AtoN task or the NAVWARN task. Such portrayal can ease the mental burden on the end user by giving specific visual details as to the impact of information. Moreover, moving AtoN information quickly from a navigational warning service into an S-125 service, or if the circumstances permit, skipping the NAVWARN service and going directly to an S-125 service can significantly reduce the clutter from NAVWARN service.

As an example, out of a total of 20646 NAVWARNs issued in Canada between March 29, 2021 and March 29, 2023, a total of 10473 were related to AtoN in some way (including cancellation NWS). This represents almost 51% of all NAVWARNs issued during this period. As such, an S-125 service with frequent updates can significantly relieve the NAVWARN service and give the end user a overview of AtoN status since the portrayal of information in S-125 is better suited to AtoN information and convey the important parts of the information more quickly than S-124 can do. This can reduce the cognitive load on an end user when having to interpret data relevant to the task at hand.

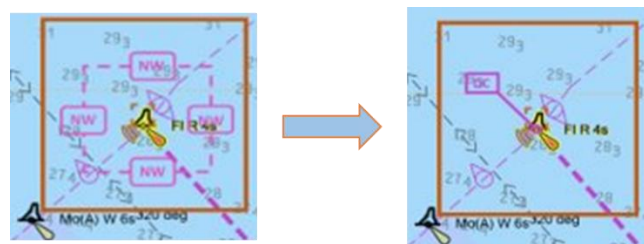


Figure 2 - visual of transition from NAVWARN to S-125

As NAVWARN has a potential distribution delay of up to 8 hours, while an S-125 service which is updated at least daily could be considered as a viable alternative for certain lower-risk AtoN information. Similarly, with NAVWARN, Notice to Mariners (NtM) have been a venue for longer term AtoN service discrepancies and preliminary notices of upcoming changes or temporary changes. Most hydrographic services fold this into the regular ENC service if the information has a duration sufficient to make sense according to the update frequency in the ENC service. This duration varies between hydrographic services from a few days to several weeks. Decreasing this duration would present ENC as an alternative for some of the information that would otherwise go into S-125, although it still could make sense to issue the information in both data streams: there is a significant link between S-57 ENC and S-101 ENC making it complicated to justify significant departures in the way the two services work; and since S-57 is a frozen standard, S-101 cannot deviate either in data model or in portrayal. In this case, S-125 is completely free to define a data model that can respond to stakeholder demands and portrayal that can do likewise. Recent interactions between IALA ARM Committee and the IHO S-101 Project Team have shown that there are significant barriers to adopting ENCs to support new AtoN developments, thus leaving S-125 as a potential means to be a quicker path for AtoN Authorities to disseminate richer AtoN information than what can be done in the ENC. This presents a good justification for why an S-125 service will be a good compliment to AtoN information in the ENC. The S-98 Interoperability Catalogue [9] will, by default, give priority to the AtoN information in the ENC, allowing only the status annotations from S-125 to be visualized. However, if the mariners have a compelling need, the full S-125 portrayal can be activated.

Since S-125 has a data model purposely built for AtoN information, it allows for better attributed data, which would also be a benefit for MASS type navigation. Since S-125 allows more data to be moved from prose into discrete data structures than S-124 permits, the data in S-125 would be better suited for MASS: the reduction in ambiguity permits the system behind the MASS navigation to do better analysis and support decision-making than what S-124. Testing these assumptions will be an essential in the coming years as competent authorities review options for how to implement S-100 services, S-124, and S-125 services. A more comprehensive understanding of the relationships and interdependencies between entities is necessary as well as validation of the service delivery paths and end user system behaviour.

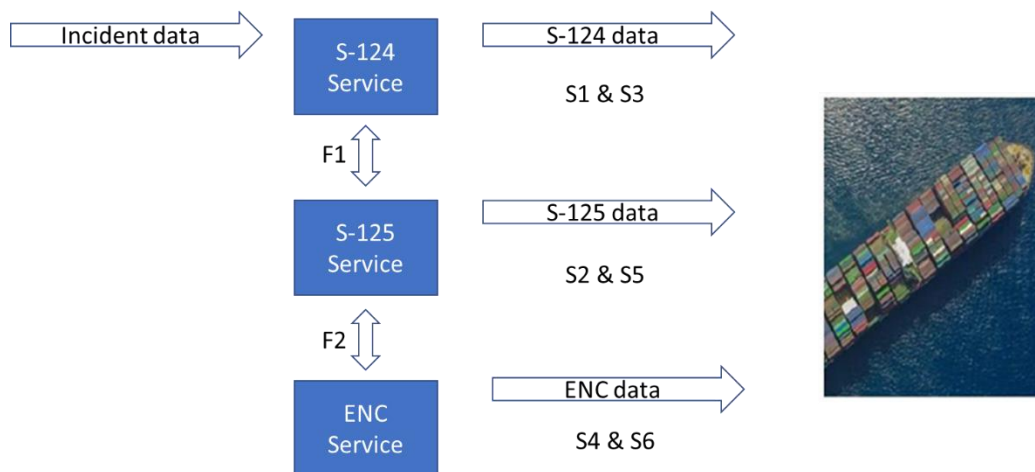


Figure 3 - Example of AtoN data dissemination sequence

Figure 3 demonstrates an example of how a sequence of data updates can be work in a scenario where there are S-124, S-125 and ENC services to support the end user. The example starts with an incident reported and a S-124 dataset (S1) created and sent to end users. This incident is of an AtoN nature and the S-124 dataset is received on the end user system using the appropriate communication channel. Within a defined time, e.g.: same day, the incident is analysed by the AtoN service through the F1 feedback loop, which confirms the incident and generates an S-125 dataset (S2) which is issued the next day, as per the nationally defined data dissemination cycle, and then received by the end user system. The publication of the S-125 dataset triggers the S-124 service via the F1 feedback loop to issue a cancellation dataset (S3) which is received by the end user system. There may be a period of several hours where the incident information is available in the end user system as both S-124 and S-125 datasets, but fine tuning the F1 feedback look can virtually eliminate this duplication. Moreover, the end user can be trained to easily understand the relationship between the services by way of visualization since S-124 will be quite basic, while S-125 will be specific to the AtoN information. In the scenario, the issue of dataset S2 is picked up in the feedback loop F2 and the ENC service is notified. A dialogue between the S125 service and the ENC service concludes that the incident will persist for a sufficient period resulting in a temporary NtM and a revision (S4) to the relevant ENC, which is disseminated by the nationally defined distribution path. The issue of the revision triggers feedback loop F2, which initiates a dialogue between the S125 service and the ENC service and a decision is taken to maintain both S125 dataset S2 and ENC dataset S4, since it gives an amplification for the end user to the seriousness of the incident. A period passes, and the incident is resolved, triggering the S125 service to issue an updated S125 dataset (S5) which removed the incident from its service. This triggers feedback loop F2, which results in the ENC service issuing an ENC revision(S6), which remove the temporary notice from the ENC.

The ECDIS systems are often thought of as the only end user system of consequence, however, since ECS and shore systems are also potential end user systems of S-124 and S-125The assumptions being built into S-124 and S-125 services should also work in non-ECDIS systems.

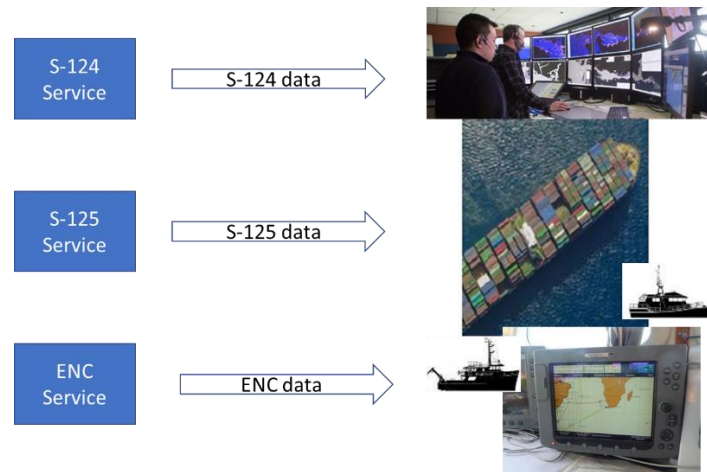


Figure 4 - Examples of users of AtoN information

Moreover, IMO recently approved amendments to the ECDIS Performance Standard and released the latest version of Resolution MSC 530(106) [10]. IHO has laid out a phased approach to the implementation of S-100 based services, where S-124 is in phase 1 and S-125 is in phase 2. It is important that S-125 development does not disrupt these plans as doing so could erode confidence in the overall process: rather, it is an opportunity for all involved in S-125 development more time to run test beds to get the details right before Phase 2 of the S-100 based services and full implementation of S-125 services is initiated.

3 CONCLUSION

All these envisioned benefits provide a strong rationale for why a S-125 service should be set up to support even safer navigation in national waters and explains why it could be advantageous to push AtoN data into an S-125 service as quickly as possible in the data dissemination process. In Figure 1, one can see that there are three avenues for AtoN information to arrive at the end user and this must be carefully managed in order to reduce the risk of confusion where different stages of the same information would require the end user to expend significant effort to deconflict the information presented. This risk is so significant that, in the opinion of the author, it risks undermining the whole value of a S-125 service and therefore necessitates careful coordination between all services that carry AtoN information to ensure that when AtoN information transitions from S-124 to S-125, there is a careful coordination to ensure integrity of the information and service. Similarly, AtoN information in S-125 should complement and enhance AtoN information in the ENC service. With S-100, where there are potentially several government services that issue data, the need for harmonization and cooperation is paramount for the end user. The goal of providing improvements to the situational awareness of the end user, must always be the priority as nations review their options for S-124 and S-125 services.

4 REFERENCES

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