Paper for Consideration by S-100WG

Introduction of S-100 Data Services with IEC 67137-2 (SECOM)

Submitted by:	Australian Maritime Safety Authority (AMSA) General Lighthouse Authorities (UK/Ireland)
Executive Summary:	IMO NCSR recently proposed an amendment to the ECDIS performance standard to include the IEC 63173-2 (SECOM) standard. This standard enables the implementation of secure maritime services that support real-time data exchange of S-100 data products. This informational paper introduces the standard and presents initial experiences with its implementation.
Related Documents:	IEC 63173-2:2022 Maritime navigation and radiocommunication equipment and systems - Data interfaces - Part 2: Secure communication between ship and shore (SECOM) IALA G1128 – The Specification of e-Navigation Technical Services IMO PERFORMANCE STANDARDS FOR ELECTRONIC CHART DISPLAY AND INFORMATION SYSTEMS (ECDIS)
Related Projects:	All S-100 related WGs and PTs

Introduction / Background

In 2019, the IMO's Maritime Safety Committee (MSC) published an initial description of Maritime Services in the context of e-Navigation (MSC.1/Circ.1610). The term Maritime Service "refers to the provision and exchange of maritime-related information and data in a harmonised, unified format." (IMO MSC.467(101)). The descriptions aim to standardise the development and implementation of the services. MSC.1/Circ.1610 defines the services on an abstract, operational level. It is expected that these services will utilise S-100 as the common maritime data structure (CMDS) and use onboard ECDISs to portray the information to the mariner.

In its latest session, the IMO MSC Sub-Committee on Navigation, Communications and Search and Rescue (NCSR) proposed the following amendment to the ECDIS performance standard:

> *"11.3.4 It should be possible to exchange, send and receive, both selected and alternative route plans with shore-based maritime service providers. The exchange should be in accordance with standard formats for route plan exchange[8] **and should use standard service interfaces including information security protection[9]** to allow for secure machine-machine communication."*
>
> *[8] IEC 61174/IEC 63173-1 [(S-421)].*
> ***[9] IEC 63173-2 (Maritime navigation and radiocommunication equipment and systems - Data interfaces - Part 2: Secure communication between ship and shore (SECOM))***

This new IEC standard extends the ECDIS' capabilities to receive and send S-100 based data sets and securely interact with (real-time) data services. Even though only referenced for the exchange of route plans, the IEC 67173-2 (SECOM) standard is payload agnostic and capable of exchanging all S-100 based data sets.

This informational paper introduces the standard and presents initial experiences with the implementation of SECOM based S-100 data services.

Analysis/Discussion

Maritime Services

The IMO defines the provision and exchange of maritime-related information and data on three different levels (see **Figure 1**):

- **Maritime Services**: Define purpose, operational approach, user needs, provided information and relation to other services. Examples are services for the provision of Maritime Safety Information, VTS data exchange or search and rescue services. Maritime Services are defined by IMO.
- **Technical Services**: Describe set of technical solutions including data model and communications means to provide a Maritime Service. Technical services are defined by domain coordinating bodies[1].

- **Data Models (S-100)**: Harmonise the representation of information in data.

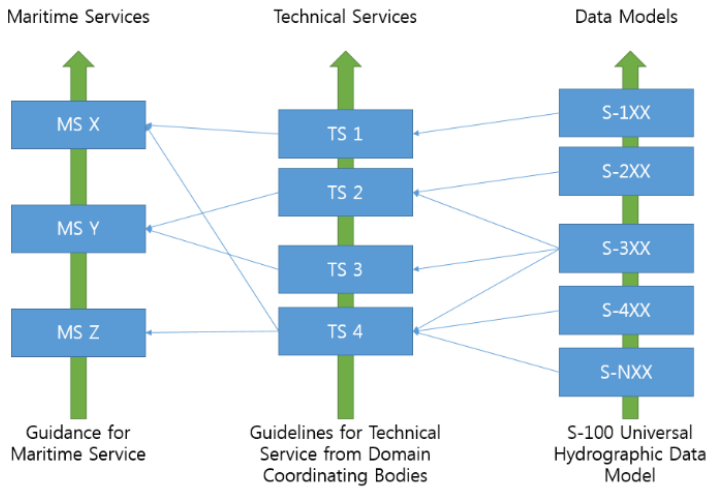


Figure 1: From: IMO MSC.467(101) - GUIDANCE ON THE DEFINITION AND HARMONIZATION OF THE FORMAT AND STRUCTURE OF MARITIME SERVICES IN THE CONTEXT OF E-NAVIGATION

Based on this categorisation, SECOM will exclusively be utilised in technical service specifications. There is no requirement to refer to SECOM in any S-XXX product specification. Further, it should be noted that the data set production is only one step in the provision of globally harmonised maritime services. In contrast to the means of distribution of S-57 charts, the provision of S-100 data is expected to be much more service-oriented. All three specification levels must be considered for the implementation of S-100 based services.

The SECOM standard

In general, SECOM provides standards for secure data exchange with technical services via the Internet Protocol (IP). It contains a technical service interface design that is in accordance with guidelines and templates from IALA and partly included in S-100. This includes data protection measures, formal API specifications, and interfaces for service discoverability. The goal is to facilitate interoperability of data exchange and reduce the need to support many different technical service designs.

[1] IALA provides guidance on how to develop technical service specifications in the guideline IALA G1128 – The Specification of e-Navigation Technical Services.

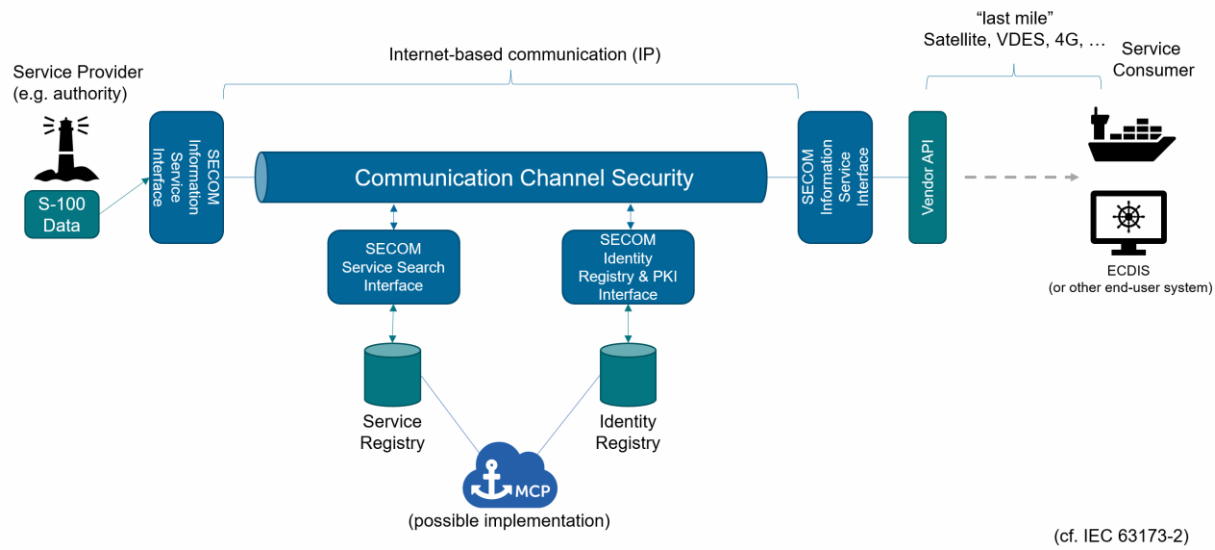


Figure 2: Overview of IEC 63173-2 service architecture.

The standard defines the following design principles:

- Any entity that wants to communicate via SECOM must implement a SECOM Information interface.
- The interfaces are defined using the REST software architecture using the HTTPS protocol.
- Data is exchanged via an end-to-end encrypted IP-based connection.
- For the data protection, the IHO S-100 data protection scheme is utilised, and additional protection is added via the SECOM protection scheme. This is, e.g., helpful when data such as S-421 route plans is produced by the end-user on a ship.
- A SECOM-compliant identity registry is utilised to manage digital identities (by utilising a Public-Key Infrastructure). This is required to digitally identify service providers and service consumers. By digitally signing data with their identity the authenticity of the data can be validated, adding an additional layer of security. SECOM provides standardised interfaces to interact with an identity registry (SECOM PKI).
- SECOM services can automatically be discovered via a SECOM-compliant service registry: Without a standardised service discoverability framework, it can be challenging and time-consuming for a ship to locate and access maritime services on a global voyage. This can result in delays, increased costs, and even safety risks. SECOM offers a solution to this problem.
- The "last mile" from the SECOM information service interface to the ECDIS is not defined by the standard. This is left to equipment manufacturers leaving them with different possibilities to implement the actual data transfer to the ship/ECDIS.
- SECOM interfaces support data filtering (e.g., by spatial geometry, area names or validity period).
- It is possible to implement services that handle multiple S-XXX data products. An example would be an under-keel clearance management (UKCM) service, that receives a S-421 route from a ship. Based on this route plan, a S-129 UKCM dataset is calculated and sent to the ship.

SECOM supports multiple communication patterns as described (with examples) in Figure 3.

- **Get** – Returns S-100 data based on filter criteria (such as geometry, validity period or identifier)
- **Get summary** – Returns a list of available S-100 data sets provided by a Service
- **Subscribe** – Creates a subscription to receive updates of S-100 data products (based on filter criteria)
- **Upload** – Can be used to push information to a SECOM entity.
- **Access management** – Used to provide data services only to authorised service consumer (e.g., after payment)

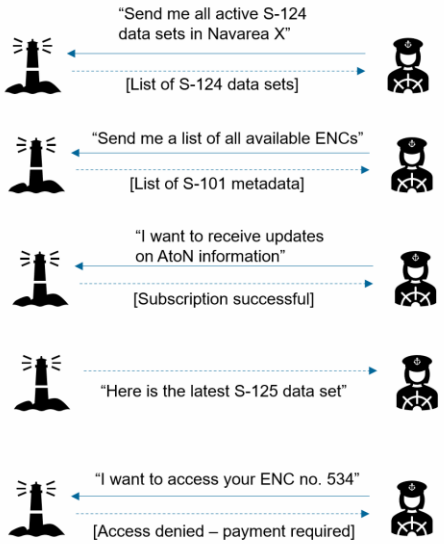


Figure 3: SECOM communication patterns.

Implementation and Testing of SECOM

As part of AMSA's digitalisation activities, a prototype SECOM service was implemented to test the provision of navigational warnings (S-124) to end-users. The implemented service follows the draft technical service specification, that is currently maintained by the Open Digital Incubator Initiative[2] WG. This specification was developed in collaboration with the IHO S-124 PT and presented at the IHO WWNWSC. Additionally, AMSA is aware of multiple other authorities currently evaluating SECOM for the provision of S-124, S-125 and VTS related product specifications.

AMSA's implementation utilised an open-source SECOM implementation, that is available on GitHub[3] and is maintained by the General Lighthouse Authorities (UK/Ireland). In general, due to the utilisation of well-established internet technologies (such as HTTPS, TLS, REST and JSON) the implementation is straight forward and easy to test. However, full compliance with the SECOM standard requires an identity registry and a service registry. To this point, the only implementation of these components is provided by the Maritime Connectivity Platform[4] (which also has as an open-source reference implementation). Even though SECOM itself is an internet-based technology it does not standardise "the last mile" to the ship. Therefore, SECOM-services will probably be compatible with other non-IP communication technologies (such as the VHF Data Exchange System (VDES)). However, to achieve interoperability, further work and analysis is required. Figure 4 and Figure 5 illustrate the demonstrator UI for the developed SECOM-service. Please note that this is not running on an ECDIS and is not compliant with the S-124 portrayal specification.

[2] see https://digitalincubator.maritimeconnectivity.net/.
[3] see https://github.com/gla-rad/SECOMLib.
[4] see https://maritimeconnectivity.net/.

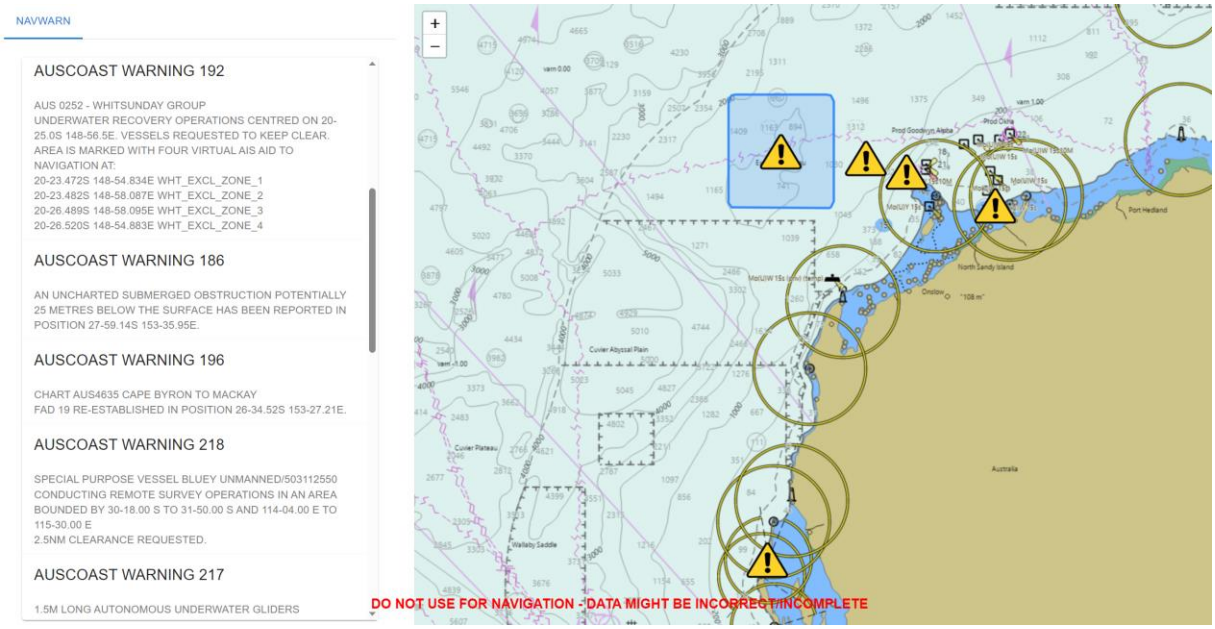


Figure 4: Demonstrator UI for AMSA's test S-124 data sets: In-force warnings overview.

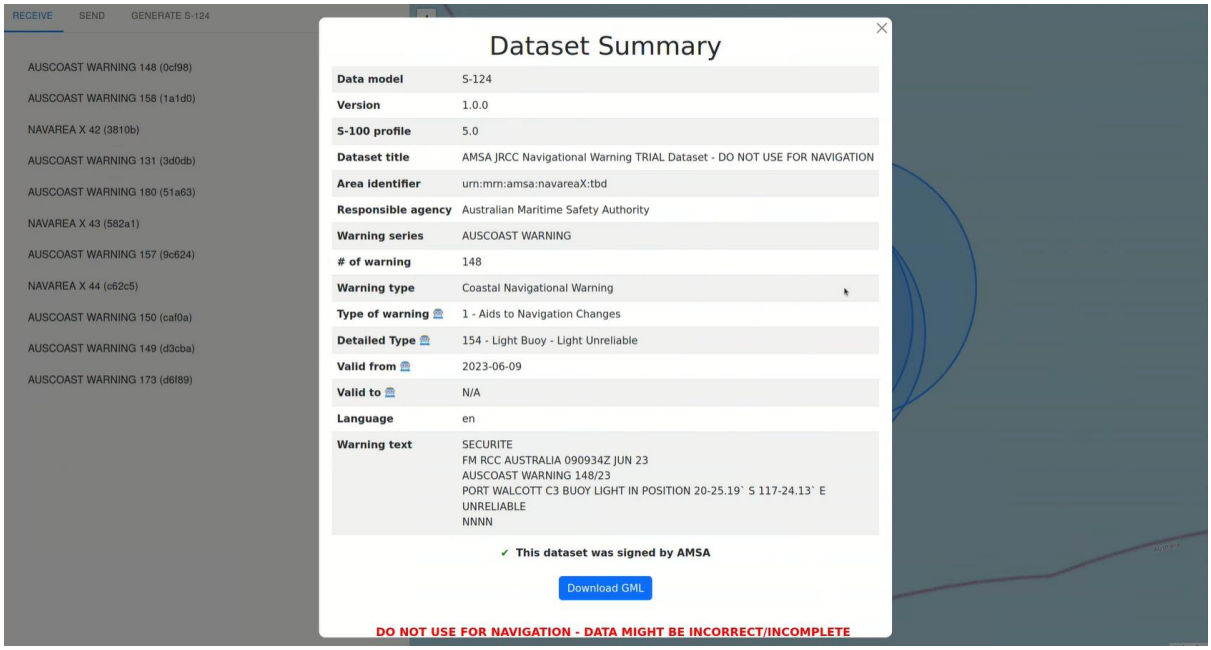


Figure 5: Demonstrator UI for AMSA's test S-124 data sets: Data set details view.

Conclusions

In summary, SECOM offers a secure and efficient way of delivering S-100 data products directly to the ECDIS. It automates the download and import of data, which is currently done manually by the mariner (in most of the cases). Furthermore, SECOM enables the introduction of interoperable real-time data services through its subscription mechanism and contributes to global harmonisation: A SECOM-compliant ECDIS can automatically find and query necessary data sets (from various authorities or service providers) along an international route. Finally, SECOM is based on modern web-technology and facilitates the integration of data services into other applications (e.g., web apps, mobile apps, PPUs, etc.).

Recommendations

It is recommended that:

1. domain coordinating bodies consider SECOM as a technology for the development of technical service specifications.
2. authorities and service providers consider using SECOM for the implementation of S-100 based data services.
3. ECDIS manufacturers consider the implementation of the SECOM interfaces in future ECDIS software.

Justification and Impacts

These recommendations are made in consideration of the proposed amendments to the ECDIS performance standard and IMO's e-Navigation strategy. They have no direct impact on the S-100 standard or other product specifications. However, the affected maritime stakeholders should consider the implementation of SECOM-based technical services as means of distribution for S-100 based data products.

Action Required of the S-100 WG

1. The S-100 WG is invited to note the provided information.