

Annex A (Informative)

Operational Contexts, Scenarios and Use Cases

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Document History

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0.0.1	28 Aug 2020	RM	First draft. Reviewed by EM.
0.0.2	01 Nov 2021	J.Powell	Numerous revisions to take into account the S-98 Correspondence Group adjudication work.
1.0.0	May 2022	S-100WG	Submission to HSSC14 for approval.
1.0.0	May 2022	HSSC	Initial published version for evaluation and testing.

A-1 Introduction

This Annex contains descriptions of operational contexts, use scenarios, and use cases for S-98 interoperability.

Section 4 in this Annex outlines the broad types of operational contexts, limited for the present to shipboard activities. Section 5 describes which products are likely to be needed for broad categories of activities within different operational contexts. Section 6 “drills down” to operational tasks and describes which S-100 products are likely to be needed for different tasks. Section 7 describes selected hypothetical use cases in which interoperability is likely to play a role.

The contexts, activities, scenarios, and use cases in this Annex are illustrative and should not be regarded as definitive prescriptions for the implementation or use of S-98 Interoperability Catalogues in ECDIS, ECS, INS, or other systems.

A-2 References

IMO A.893(21) *Guidelines for voyage planning*, IMO resolution A893(21), 25 November 1999.

MSC.232(82) *Revised Performance Standards for Electronic Chart Display And Information Systems (ECDIS)*, IMO Resolution MSC.232(82), 2006.

ICS 2016 *Bridge Procedures Guide*, 5th Edition, International Chamber of Shipping, London (2016).

A-3 Terms, Definitions and Abbreviations

A-3.1 Use of language

The usages specified in clause 1.3.1 (Use of language) of the “S-98 – Main” document apply to this Annex.

A-3.2 Terms and definitions

Alarm

A high-priority **alert**. Condition requiring immediate attention and action by the bridge team, to maintain the safe navigation of the ship.

Alert

Announcement of abnormal situations and conditions requiring attention. Alerts are divided in four priorities: **emergency alarms**, **alarms**, **warnings**, and **cautions**. An alert provides information about a defined state change in connection with information about how to announce this event in a defined way to the system and the operator.

Caution

Lowest priority of an **alert**. Awareness of a condition which does not warrant an **alarm** or **warning** condition, but still requires attention out of the ordinary consideration of the situation or of given information.

A-3.3 Abbreviations

OOW	Officer Of the Watch
AML	Additional Military Layer
ECDIS	Electronic Chart Display and Information System
ECS	Electronic Charting System

FC	Feature Catalogue
GMDSS	Global Maritime Distress and Safety System
GNSS	Global Navigation Satellite System
IHO	International Hydrographic Organization/Organisation Hydrographique Internationale
IMO	International Maritime Organization
INS	Integrated Navigation System
MSC	Maritime Safety Committee (IMO)
MSI	Marine Safety Information
PC	Portrayal Catalogue
PPU	Portable Pilot Unit
PS	S-100-based Product Specification
UKC	Under-keel Clearance
UKCM	Under-keel Clearance Management
VTS	Vessel Traffic Service

A-4 Operational Contexts

In the e-Navigation concept, two scopes are defined: The ship side; and the shore side services. The S-100 concept meets the need for a Common Maritime Data Structure (CMDs). The proposed approach only focuses on the ship side. In the literature (regulation, navigation guide, study on e-navigation), navigation is defined according to two functionalities: Voyage planning; and execution of voyage plan and other officer of the watch (OOW) tasks, often summarized as “route monitoring”. The role of the future ECDIS on the bridge has to be defined regarding these two functionalities in accordance with IMO regulations. Identification of use cases on the bridge is needed to answer which S-100 products are expected for ECDIS and for other bridge equipment. We are in the case of human navigation, but the approach is not in conflict with the emerging autonomous ship navigation.

According to the Bridge Procedures Guide of the International Chamber of Shipping [ICS 2016], the four stages to achieve a safe passage plan are:



Figure A-1 - Passage planning stages (from [ICS 2016])

These four steps can be summarized in two use cases: The voyage planning; and the monitoring / execution of voyage planning, as defined in IMO regulations.

A-4.1 Voyage planning

This activity is usually performed in a relatively quiet area, on the back end of the bridge, on a chart table. It is done ahead of departure or can be conducted during long ocean passage. The officer of the watch gathers the information needed for the voyage plan from berth to berth; and may vary in format, relevance and frequency of updating. The OOW is normally available to spend a reasonable amount of time to understand information at their disposal to prepare the route: Sorting; analysis; selection of a travel planning scenario. It may require reading literature if the information is not directly understood; the OOW has the possibility to read it again, to analyse and to do a cross-reference between different information. With S-100 products, most of the information becomes georeferenced-information. Cross-reference process is more efficient.

ECDIS in route planning mode is the regulated system for designing and checking the planned route. The OOW needs the following information:

Ocean routes:

- Climatological and oceanographic seasonal conditions, ocean currents, ice limits, load lines;
- Meteorological information;
- Services for weather routeing;
- Environmental protection measures;
- Ship' routeing and reporting system, VTS;
- Navigational warnings;
- Volume of traffic likely to be encountered;
- Landfall conspicuous landmarks;
- MSI services and communications;
- Regulatory areas: Emission control areas.

Coastal routes:

- Charted features and other features for safe distance;
- Available depth of water including tidal water level information;
- UKC requirements and other limiting conditions;
- Currents, tidal currents;
- Landmarks and AtoNs, availability of visual and radar fixing opportunities;
- Recommended routes and channel information, local conditions and restrictions on navigation, traffic likely to be encountered;
- Navigational warnings;
- Pilotage requirements and services, procedures (a pilotage plan is required);
- Port requirements, port facilities, procedures for port entry;
- Reporting and communication procedures;
- Details of the prospective berth and anchorages;
- Meteorological information;
- Environmental protection measures.
- Ship' routeing and reporting system, VTS;
- MSI services and communications.

Berthing / pilotage:

- Arrival intentions including embarkation time, arrangements for cargo discharge and bunkering;
- Communications should be established with Pilot, port VTS and port authorities as appropriate;
- Pilotage plan subject of Master/pilot information exchange (MPX);
- Updates on local conditions such as weather, depth of water, tides and tidal streams, traffic conditions;
- Information on berthing arrangements including the use, characteristics and number of tugs, mooring boats, mooring arrangements and other external facilities.

IMO A.893(21) contains guidelines for voyage planning.

A-4.2 Route monitoring

This task is performed at the front of bridge, as the OOW needs to have a control view of the environment, especially when the ship is approaching harbour and entering coastal waters. The OOW normally executes the voyage planning previously defined. The voyage plan is normally stored and can be followed on an ECDIS (route monitoring mode) integrated in an INS (Integrated Navigation System). The need of synthetic, unambiguous and clear information is essential, as decision-making needs to be rapid in the face of any events that may occur (anti-collision, anti-grounding). It is necessary to reduce the number of manipulations to be carried out on the system (ECDIS) and reduce its mental workload as much as possible.

A part of the monitoring can be done with the help of the ECDIS, including monitoring of the following:

- The ship's current position and proximity of dangers to navigation;
- The intended track (passage plan), course and speed, cross-track deviation;
- The traffic situation and the traffic density to be encountered;
- The vessel reporting requirements, completed or due;
- The environmental requirements;
- Weather conditions to be encountered including sea state and visibility;
- Uncharted navigational hazards which may be encountered.

The OOW should:

- Follow the passage plan and monitor the progress of the ship;
- Make a full appraisal of the risk of collision with other vessels;
- Identify navigational hazards such as wrecks, floating objects, ice and uncharted hazards;
- Determine the risk of grounding or stranding (UKC);
- Detect and respond as appropriate to any significant change in the weather, visibility or sea state;
- Identify navigational marks;
- Perform position fixing of the ship by all appropriate means;
- Take action to avoid collision;
- Amend the passage plan:
 - Permanently (the passage planning phase is repeated). Examples of causes are weather routing developments, change of destination, or search and rescue response.
 - For a deviation from the current plan. Examples of causes are COLREG issues, variations of weather conditions, advice received from VTS, navigational warnings, detected hazards.
- Monitor GMDSS watch keeping (radio, emergency, MSI, routine and general communications).

A-5 Product Collections for Operational Contexts

Since different operating contexts (for example, passage planning, route monitoring, etc) will involve loading different collections of data products; and since they are likely to be more or less the same for the same class of end-user, it may be useful to specify pre-defined collections or “base collections” of products which can be loaded by the user under specific conditions or for specific tasks. An ECDIS would allow the user to select from a list of pre-defined product combinations instead of loading and unloading individual data products. SOLAS V or other external requirements should be taken into consideration.

It is envisaged that the ECDIS will allow end-users to adapt the collections or customize them by changing the load sets, selecting portrayals, changing context parameters and user settings, etc. Customized collections can be saved – thereby allowing operators, masters, and bridge officers to add to the library of pre-defined collections available on the ECDIS. Either initial or customized collections can be reloaded at a later time. Users can also load additional data products, real-time information (for example, radar, AIS) or unload one or more of the default products after a pre-defined collection is loaded.

The classifications and loading in Table A-1 below are intended for illustrating interoperability use cases and not a prescription for ECDIS or requirements of performance standards.

N: Not loaded.

Y: Loaded.

O: Optional (loaded or unloaded at user option).

C: Customized subset of features; for example, a subset selected by feature type, attribute value, or creation time.

“Other products” are products that are not covered by S-98 (see Table 1-1 in the “S-98 – Main” document).

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Table A-1 - Operational contexts and data products

Collection Purpose	Product						Remarks
	S-101 ENC	S-102 Bathymetric Surface	S-111 Surface Currents	S-104 Water Level Information	S-129 Underkeel Clearance Management	Other products: S-411 (Sea Ice); S-412 (Weather and wave hazards); S-413 (Weather and wave conditions); S-124 (Navigational warnings)	
Voyage and route planning							
Voyage planning	Y	N	N	N	Y	S-411 (O) S-412 (C) S-413 (C) S-124 (Y)	The voyage plan defines the start and end of the voyage and the intended transit time considering the ship's parameters. S-411, S-412, S-413, S-124 areas may be bypassed depending on their status and active time.
Route planning, ocean or offshore voyage	Y	N	Y	N	Y	S-411 (O) S-412 (C) S-413 (C) S-124 (Y)	Depth and current data may affect time of harbour entry. S-412, S-413 as relevant to track.
Route planning, coastal voyage	Y	Y	Y	O	Y	S-411 (C) S-412 (C) S-413 (C) S-124 (C)	S-411, S-412, S-413, S-124 – as relevant to vessel track.
Route monitoring							
Route monitoring, ocean	Y	N	O	N	N	radar, ARPA, AIS S-411 (Y) S-412 (Y) S-413 (Y) S-124 (C)	S-124 – as relevant to track.

Route monitoring, coastal	Y	N	Y	N	Y	radar, ARPA, AIS S-411 (Y) S-412 (Y) S-413 (Y) S-124 (C)	S-124 – as relevant to track.
Route monitoring, congested waterways (e.g. TSS)	Y	N	Y	N	N	radar, ARPA, AIS S-411 (Y) S-412 (O) S-413 (O) S-124 (Y)	
Route monitoring shallow waterways	Y	Y	Y	Y	Y	radar, ARPA, AIS, UKCM S-412 (C) S-413 (C) S-124 (Y)	S-412, S-413 – as relevant to track.
Route monitoring, port approach/departure (Piloting)	Y	Y	Y	Y	Y	radar, ARPA, AIS S-411 (O) S-412 (C) S-413 (C) S-124 (Y)	S-412, S-413 – as relevant to track. Also on PPU.
Other operations							
Berthing	Y	Y	N	Y	N	specialized products	Assumes S-129 datasets are not available within harbours. Also on mobile or special display or specialized apps.
Harbour movement	Y	Y	Y	Y	N	specialized products	Assumes S-129 datasets are not available within harbours. Also PPU.
Transit of bridge	Y	Y	C	C	O	S-124 (C); specialized products	Also on mobile or other display, or specialized apps.

A-6 Operational Activities and Products

This section summarizes shipboard activities and the data products likely to be needed for each.

At present this section addresses only activities in the route monitoring context.

A-6.1 Route monitoring activities

Table A-2 below summarizes the tasks related to route monitoring activity; the information needed by the OOW; and the related S-100 products.

Table A-2 - Route monitoring activities and products

Activities of OOW for route monitoring	Information	S-100 products
Follow the passage plan and monitor the progress of the Ship	Route, GNSS, chart, voyage plan	S-101
Make a full appraisal of the risk of collision with other vessels	GNSS, AIS, radar	(none)
Identify navigational hazards such as wrecks, floating objects, ice and uncharted hazards	Chart, navigational warning, sea ice observations	S-101 S-124 S-411
Determine the risk of grounding or stranding (UKC)	Chart, high density bathymetry, UKC, voyage plan	S-101 S-102 S-104 S-129
Detect and respond as appropriate to any significant change in the weather, visibility or sea state	Weather forecasts	S-412
Identify navigational marks	Chart, voyage plan	S-101
Position fixing of the ship by all appropriate means	Chart, radar	S-101
Take action to avoid collision	GNSS, chart, voyage plan	S-101
Amend the passage plan permanently (the passage planning phase is repeated) - Causes: weather routeing developments, change of destination, SAR response deviation, COLREGs, variations of weather conditions, advice received from VTS, NWS, detected hazards	Chart, SAR information, weather forecast, nav. warnings, VTS information	S-101 S-111, S-104, S-124, S-411, S-412, S-413
GMDSS watch keeping (radio, emergency, MSI, routine and general communications)	Chart, voyage plan	S-101

A-7 Use Cases

A-7.1 Bathymetry replaces soundings

Goal: Given an overlay certified as a suitable replacement, replace the corresponding ENC features with features from the overlay.

Actors: OOW; ECDIS.

Description: S-102 (Bathymetric surface) gridded data is displayed over an ENC. The S-102 data is certified as an allowable replacement for appropriate ENC features. Depth areas, dredged areas and soundings with multi-point geometry are replaced with bathymetric surface features. Depth contours are re-computed based on S-102. Alerts trigger when the safety contour is crossed. Contours are computed on gridded data using an algorithm to be determined by the S-102 Project Team.

A-7.2 Suppression of parts of underlying ENC data

Goal: ENC data is hidden when data intended to suppress ENC data is loaded.

Actors: OOW; ECDIS.

S-111, S-411 and S-412 will have similar operations where parts of the underlying ENC data may be suppressed while the product is on the screen.

S-111 is coverage data while S-411 and S-412 are vector data so this has 2 variant sub-cases (described below). The actors are as mentioned above for both.

A-7.2.1 Sub-case: Suppression of ENC information with coverage data - S-101 and S-111

Description: S-111 (Surface Currents) coverage features suppress any S-101 current features (**Current – Non-Gravitational, Tidal Stream – Flood/Ebb**). S-101 **Water Turbulence** features are retained since they are not covered by S-111.

A-7.2.2 Sub-case: Suppression of ENC data with vector data - S-101 and S-411 and S-412

Description: Ice area features from S-411 (Sea Ice) suppress any overlapping S-101 **Ice Area** features. S-412 (Weather and Wave Hazards) has **Ice Edge** and **Limit of Known Ice** features – they can suppress S-411 ice features via rule-based interoperability operations depending on factors such as which data is more recent.

A-7.3 Bridge with air gap and wind information

Goal: The navigator can filter out information by user-defined areas, time, and thematic attributes.

Actors: OOW (or barge skipper, or river pilot); ECDIS.

Description: Bridge with wind and air gap broadcasting, navigator reviews data two hours before crossing and makes the go/no-go decision. In the “go” scenario, the navigator might have the air gap data until the bridge is 5 minutes away and remove the information but keep the wind information visible for the whole bridge crossing. This scenario implies the ability to show partial information in a very specific area for any length the navigator deems necessary.

If, hypothetically, S-412 has both wind and water level information in the same feature type. So “partial information” would mean writing an Interoperability Catalogue rule for filtering down to the attribute level, by space, and time.

A-7.4 Passage / route planning

Goal: The system can be configured to display different types of information needed to plan the route for a voyage.

Actors: Passage planner (OOW, navigation officer, mate, planner in shipping company office); ECDIS.

Description: ENC, UKCM, navigational warnings, and bathymetric surface data are used in a back-of-bridge scenario to plan the route for a voyage. The planner may turn on or off different viewing groups or sets of features from different data products so as to provide information about particular aspects of the planning problem without adding clutter by including irrelevant feature types or attributes.

A-7.5 Route monitoring

Goal: The system can be configured to display different types of information needed to monitor the vessel's route.

Actors: OOW; ECDIS.

Description: This is the classic “ECDIS” situation. During route monitoring in different circumstances, what are the combinations of information the bridge officers want to see on the ECDIS? All the datasets? Subsets of feature types from some datasets? Sub-cases are defined in the subsections below. (Actors for the sub-cases are mentioned where they may be different from the base case.)

A-7.5.1 Sub-case: Ocean passage

Products needed on the display are S-101, S-111 (if available for ocean currents), S-124 for NAVAREA warnings, S-411 (if available, for icebergs); S-412 and S-413 for weather and waves.

A-7.5.2 Sub-case: Coastal route monitoring

Products needed on the display are S-101, S-102 (depths and safety contour – the latter computed from data), S-111 (currents), S-124 (warnings about nav aids, hazardous conditions, etc – coastal warnings), S-411 (ice), S-412 and S-413 (weather and wave hazards and conditions).

A-7.5.3 Sub-case: Navigation in harbour approaches

Products needed are S-101, S-102 (depths and safety contour), S-111 (currents), S-124 (local warnings), S-411 (ice), S-412 and S-413 (weather and wave hazards and conditions).

A-7.6 Entering or departing harbour

Actors: OOW; pilot; tug operator; ECDIS; PPU.

Products needed are S-101 for harbour and berth information, S-104 for water levels, S-102 for bathymetry, S-129 for under keel clearance – all only if sufficiently large scale data (or scale-independent data) is available and only in a relatively small area.

A-7.7 Operations within harbours

Actors: OOW; harbour pilot; tug operator; harbourmaster’s office; ECDIS

Products needed are S-101, S-102, S-111, S-104, S-124, other data products specific to the harbour, such as a terminal map. Will probably have additional information too, specific to the berth and other inputs; for example, sensors for distance measurements. In fact, berthing might not use an ECDIS at all (see clause 7.10).

A-7.8 Operations in narrow channels

Actors: OOW; pilot or river pilot; ECDIS.

Products needed are S-101, S-102, S-104, other data products specific to the channel.

A-7.9 Operations in congested waters

Actors: OOW; deep sea pilot; VTS controller; ECDIS; VTS display.

Products needed on the display are S-101, S-102, S-104, other data products specific to the waterway if any.

A-7.10 Berthing

Actors: OOW; pilot; terminal operator; tug operator; ECDIS; PPU; or custom application.

A large vessel approaching a berth, possibly assisted by tugs and S-101 for harbour and berth information, S-104 for water levels, S-102 for bathymetry – all only if sufficiently large scale data is available and only in a relatively small area. Will probably have additional information too, specific to the berth and other inputs; for example, sensors for distance measurements. In fact, berthing might not use an ECDIS at all, but other specialized equipment that uses only a subset of S-101 information (possibly in a specialized berthing chart) plus water level and depth data plus specialized sensors and may be partially guided from shore.