D6.4 Service for SRS reporting

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Document Status

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0.5	2018-04-26	R.N.	Added Rolands updated text about ReX
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Review

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1 SRS reporting – scope

In defining this delivery three different perspectives were considered to cater for Ship Reporting System (SRS) reporting. SRS reporting requirements, SRS reporting from all ships and SRS reporting from Sea Traffic Management (STM) ships.

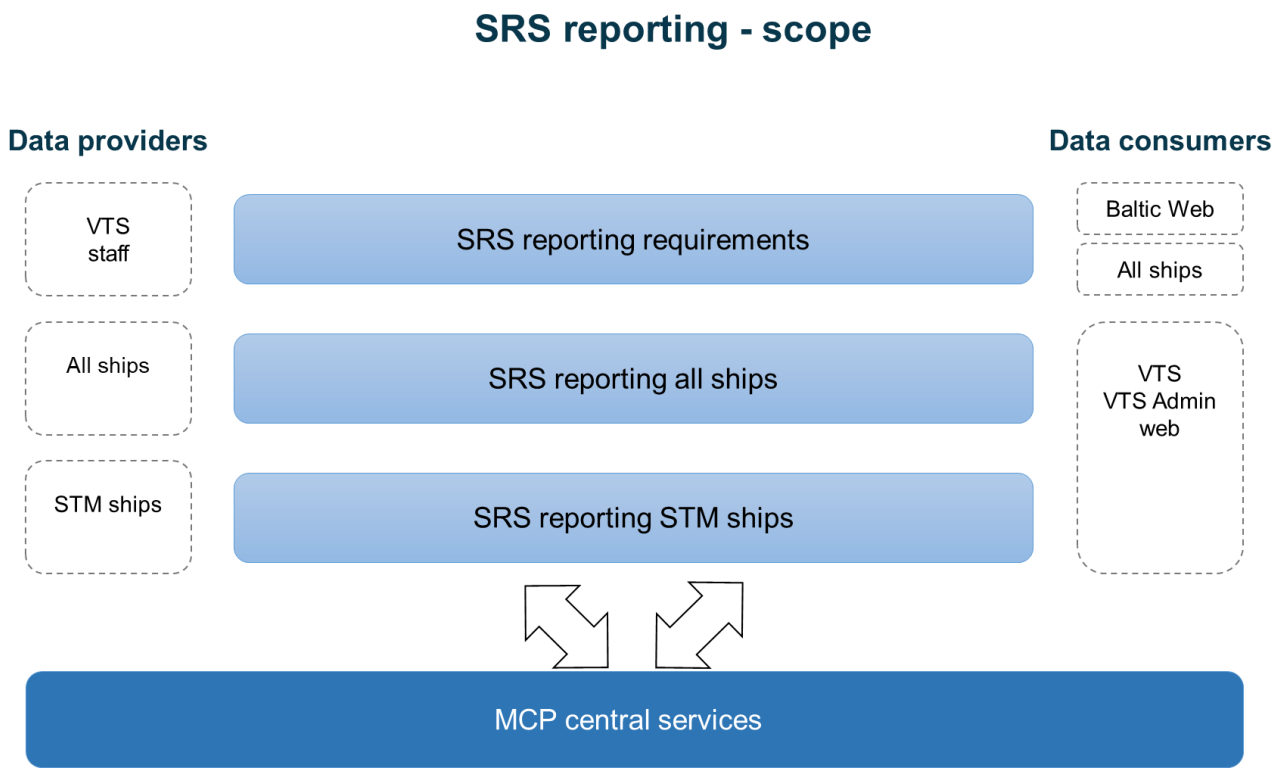

Figure 1. SRS reporting deliverable - scope

SRS reporting requirements

Firstly a service was developed for distributing SRS reporting requirements which can be utilized by ships approaching an SRS area offering the possibility to request reporting requirements both in a human readable manner and through a machine to machine interface.

Data providers are resp. Vessel Traffic Service (VTS) staff defining the SRS reporting requirements.

This service can be consumed in either Baltic Web (human machine interface) or via on-board systems (machine to machine interface). The consumers of submitted SRS reporting requirements apply to all ships.

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SRS reporting all ships

Secondly a web solution was developed for submitting SRS reports to SOUND VTS which can be utilized by all ships, see chapter 2 Reporting to SOUNDREP. Data consumers of submitted reports are VTS staff. An administrator web application “VTS Admin” has also been developed to facilitate VTS staff viewing of submitted reports.

SRS reporting STM ships

Thirdly an SRS report format is developed to cater for machine to machine sending of SRS reports from STM equipped ships. This is facilitated through an extension to the Route Plan Exchange Format (RTZ) being used in Voyage Information Service (VIS). This approach was considered good since it is possible to utilize already developed services within STM, additionally, the SRS extension complies with the standard format RTZ 1.1.

1.1 SRS reporting requirements

The SRS Format Service is targeting the SRS reporting requirements for a VTS. Subsequently the SRS report can then be submitted, approaching or when entering a VTS coverage area, according to SRS reporting requirements defined in the SRS Format Service for a specific VTS.

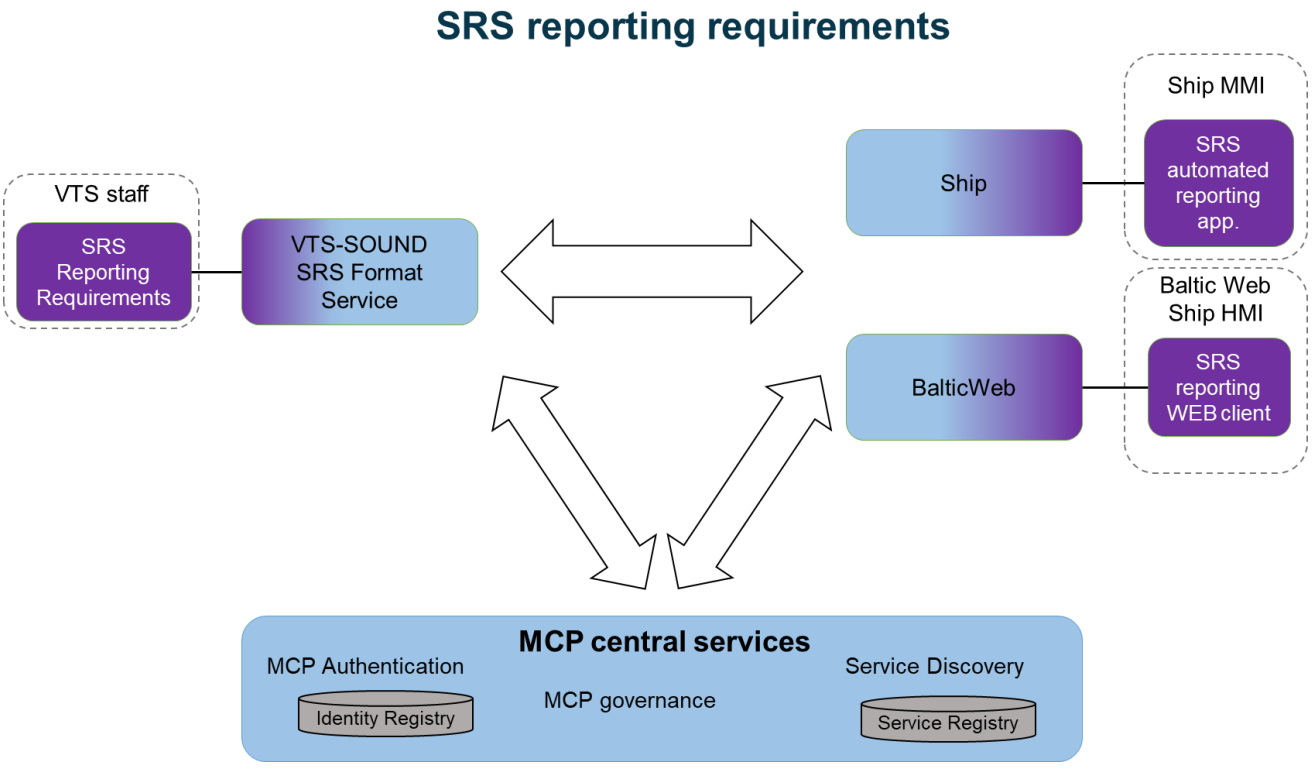

Figure 2. SRS Format Service

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VTS staff start by defining the required SRS report designators in a file which is uploaded to the SRS Format Service. This file determines the SRS reporting requirements for the actual VTS. Two different formats are supported, one for Human Machine Interface (HMI) interpretation and another for Machine to Machine Interaction (MMI) consumption.

In using the SRS Format Service a reporter situated on a ship can choose to use the BalticWeb HMI to search for SRS Format Services in the proximity of the actual ship. The built-in search function in BalticWeb, searches the MCP service registry for SRS Format Services using exposed Maritime Connectivity Platform (MCP) Service Registry Application Programming Interface (API). In the simplest case this is facilitated by right clicking on a map on an exposed VTS location.

The required SRS report format is downloaded and presented to the user in a BalticWeb form, for the user to fill out. After filling out the form the submitted SRS report is sent to the contact as stated in the SRS Report Format Service for the actual VTS.

As an alternative an on-board system can consume the SRS Report Format Service to automatically submit SRS reports to selected VTS's based on downloaded SRS reporting requirements in the SRS Format Service, by use of the exposed MMI interface. This SRS reporting can be triggered when the ship is approaching a VTS reporting line.

1.2 SRS reporting all ships

To facilitate SRS reporting from ships, regardless if they are STM equipped ships or not, without a pre-built MMI to onboard systems, a web form was developed. Furthermore yet another web application was developed to cater for SRS report processing implementing a MMI to a database impersonating a VTS system REP database. The latter was developed as a proof of concept to pave the way for possible live implementations following the EfficienSea2 project. See chapter 2 for a more in depth description of an example implementation in SOUNDREP:

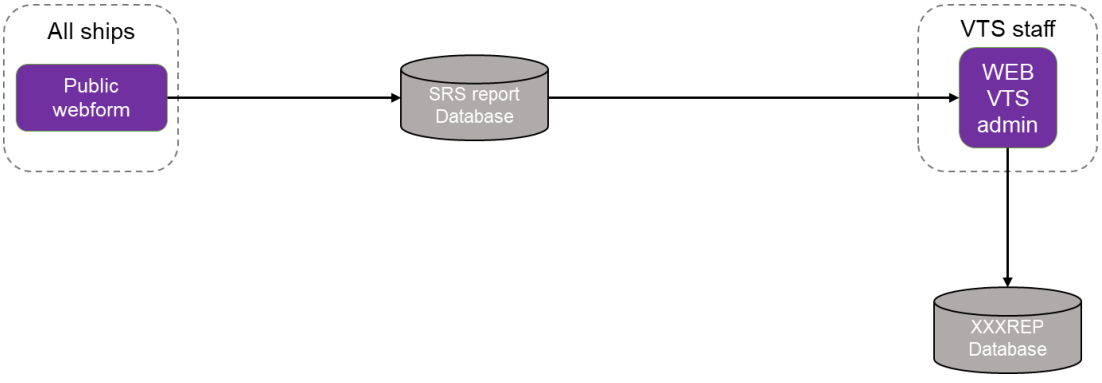

Figure 3. SRS reporting all ships

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1.3 SRS reporting STM ships

Within EfficienSea2 an STM payload format for RTZ 1.1 has been extended to cater for SRS reports in addition to describing a ship's route. The RTZ 1.1 format has built in nodes for extension possible to use for arbitrary purposes.

STM is running in System Wide Information Management (SeaSWIM) by use of MCP issued certificates for authentication and encryption. The orange coloured items in the picture below describes SeaSWIM defining an own security domain within MCP. SeaSWIM Connector (SSC) handles this connection to SeaSWIM by use of authentication and encryption functionality. Furthermore the VIS has functions for handling exchange of routes (in RTZ 1.1), to and from a ship or service provider. VIS is considered a standard interface, developed within STM, which can be put in front of every service exchanging routes.

In the picture below a VIS is impersonating a ship and an SRS reporting application service to facilitate the transfer of SRS reports to the web application VTS admin. Also shown in the picture are the different security mechanisms used between the various applications.

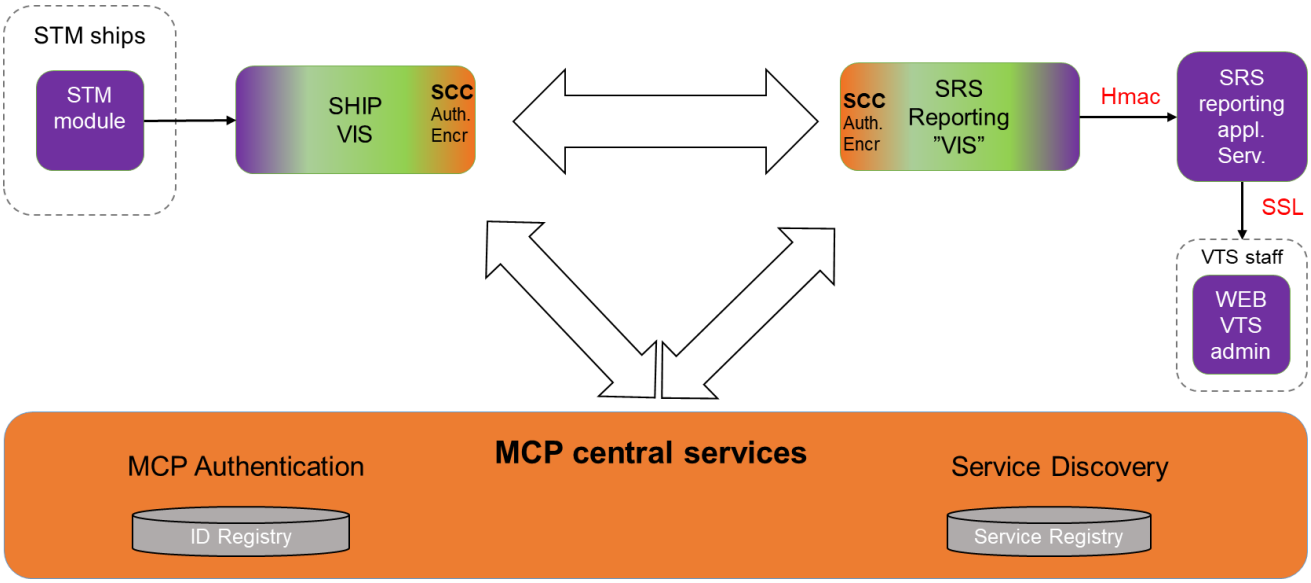

Figure 4. SRS reporting – STM ships

Aside from supporting Mandatory Ship Reporting System (MRS) requirements and SRS requirements according to VTS's preferences, submitted SRS reports also include SafeSeaNet (SSN) requirements, as stated in the section below.

All the requirements related to SSN defined by the following legal instruments: Directive 2002/59/EC as amended (establishing a Community vessel traffic monitoring and information system) and Regulation (EC) No 725/2004 (on enhancing ship and port facility security).

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Which in fact means supporting designators defined in the following SSN messages:

- MS2SSN_Ship_Not.xml message
- MS2SSN_Exemption_Not.xml message
- MS2SSN_Ship_Res.xml message

Furthermore a review is made with regards to SRS reporting requirements in the following VTS areas to include in the reporting requirements in the SRS Format Service.

- BELTREP - Great Belt VTS (DK)
- SOUNDREP - Sound VTS (SE & DK)
- GOFREP - Tallinn VTS (EE), Helsinki VTS (FI) , St. Petersburg VTS (RF)
- STRAITREP - Klang and Johor VTS (MY), Singapore VTS (SG)
- BAREP - Murmansk VTS (RF), Vardø VTS (NO)
- OUESSREP - CROSS Corsen (FR)
- GDANREP - Gdańsk VTS (PL)

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2 Reporting to SOUNDREP

SOUNDREP is a “MANDATORY SHIP REPORTING SYSTEM ‘IN THE SOUND BETWEEN DENMARK AND SWEDEN’” (NEW MANDATORY SHIP REPORTING SYSTEM "IN THE SOUND BETWEEN DENMARK AND SWEDEN" (SOUNDREP), 2010).

This chapter will describe how reporting has been done before the EfficienSea2 project and also how reporting to SOUNDREP has changed because of the EfficienSea2 project.

To demonstrate the solutions that were developed a presentation was made. This presentation is available at richardnilssonsma.github.io. On the first page of the presentation there is a link to a video of the same presentation which is available at richardnilssonsma.github.io/videos/vts-srs-reporting-video-presentation.mp4.

2.1 Before the EfficienSea2 project

Before the EfficienSea2 (E2) project the two only available means of reporting to SOUNDREP were via Very High Frequency (VHF) radio and by sending a regular e-mail with all necessary information to contact@soundvts.org.

2.1.1 Reporting via VHF

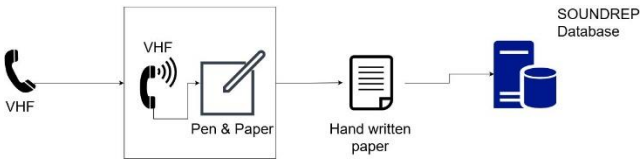

Figure 5. Reporting via VHF

Assuming a ship approaches the SOUNDREP area without having visited the SOUNDREP website (www.soundvts.org), the only available mean of reporting would be to report all necessary information via voice VHF.

The VHF channel could be found by looking at a sea chart but the requested information is not available to the seafarer upon entry. This means that the Vessel Traffic Service Operator (VTSO) would need to ask for all necessary information from the seafarer. Since the seafarer would be unaware of what information that needs to be provided the seafarer would most

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likely have to pause the conversation several times to find and calculate requested information such as remaining bunker fuel on board and the vessel's air draught.

One particularly difficult information point when it comes to a seafarer passing through the Sound for the first time is the point where the intended route has to be provided. This information point can take several minutes to provide as the seafarer is unaccustomed to the area and thusly has to consult his planned route and sea chart several times to find out what requested information has to be provided.

2.1.2 Information about SOUNDREP found in Sea Chart

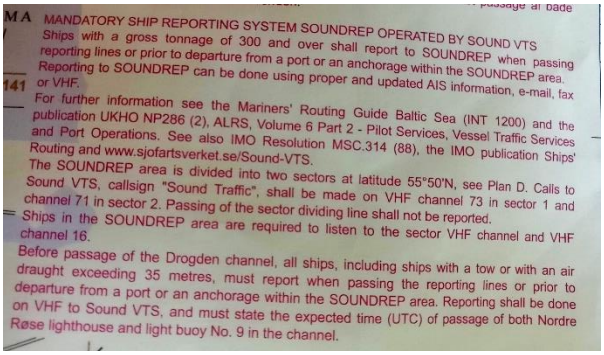
MANDATORY SHIP REPORTING SYSTEM SOUNDREP OPERATED BY SOUND VTS
Ships with a gross tonnage of 300 and over shall report to SOUNDREP when passing reporting lines or prior to departure from a port or an anchorage within the SOUNDREP area. Reporting to SOUNDREP can be done using proper and updated AIS information, e-mail, fax or VHF.
For further information see the Mariners' Routing Guide Baltic Sea (INT 1200) and the publication UKHO NP286 (2), ALRS, Volume 6 Part 2 - Pilot Services, Vessel Traffic Services and Port Operations. See also IMO Resolution MSC.314 (88), the IMO publication Ships' Routing and www.sjofartsverket.se/Sound-VTS.
The SOUNDREP area is divided into two sectors at latitude 55°50'N, see Plan D. Calls to Sound VTS, callsign "Sound Traffic", shall be made on VHF channel 73 in sector 1 and channel 71 in sector 2. Passing of the sector dividing line shall not be reported.
Ships in the SOUNDREP area are required to listen to the sector VHF channel and VHF channel 16.
Before passage of the Drogden channel, all ships, including ships with a tow or with an air draught exceeding 35 metres, must report when passing the reporting lines or prior to departure from a port or an anchorage within the SOUNDREP area. Reporting shall be done on VHF to Sound VTS, and must state the expected time (UTC) of passage of both Nordre Røse lighthouse and light buoy No. 9 in the channel.

Figure 6. Information in Sea Chart INT 1333

"MANDATORY SHIP REPORTING SYSTEM SOUNDREP OPERATED BY SOUND VTS

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2.1.3 Reporting via e-mail

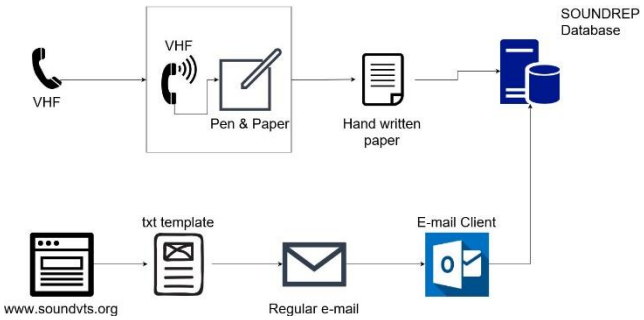

Figure 7. Available means of reporting before E2

As stated in the sea chart INT 1333, Sound VTS can also receive reports via e-mail. A txt-template is provided at www.sjofartsverket.se/pages/101951/SOUNDREP_Template.txt which the seafarer can copy into a regular e-mail and then fill out the requested information.

```
"E-mail template for SOUNDREP report"

TO: CONTACT@SOUNDVTS.ORG
SUBJECT: SOUNDREP SHIP REPORT

A/VESSEL NAME/CALL SIGN

B/ETA SOUNDREP

I/DESTINATION, ETA

L/DISKEN, DW OR DE
L/VEN, VW OR VE
L/CHANNEL, D OR F

O/DRAUGHT

P/TYPE OF CARGO, IMO CLASSES AND QUANTITY

T/DESIGNATED PERSON

U/AIR DRAUGHT

W/PERSONS ONBOARD

X/BUNKERS
```

Figure 8. txt-template

Additional information about the monitoring area of SOUNDREP is also available at www.sjofartsverket.se/pages/101951/SoundVTS_folder.pdf, in the form of a pdf-pamphlet that can be printed and kept by the seafarer on the bridge for easy access.

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2.2 Developed within the EfficienSea2 project

Two solutions that reduce administrative burden for seafarers and VTSO's have been developed within the E2 project.

The first digital solution for reporting is the SOUNDREP Web Form which is found at www.sjofartsverket.se/en/Sound-VTS/Reporting/Online-reporting/.

The second digital solution has been developed for use internally at Sound VTS. A web application that goes under the working name of VTS Admin has been developed to display and manage reports that have been sent via the SOUNDREP Web Form.

2.2.1 Reporting via SOUNDREP Web Form

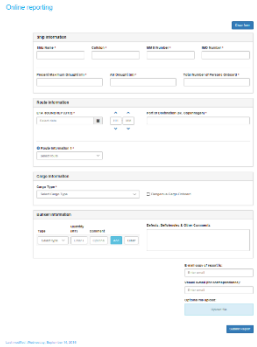

Figure 9. SOUNDREP Web Form

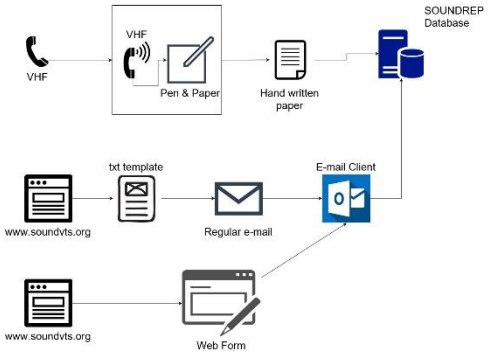

Figure 10. Web Form added to means of reporting

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A seafarer with a regular internet connection can find their way to the SOUNDREP Web Form by going to www.soundvts.org and follow links to the Web Form.

The Web Form will provide the seafarer with information fields that cover all necessary information that has to be provided to Sound VTS upon entry into the VTS monitoring area.

All information fields are validated in the web browser which means that sent reports are complete and correct. If a report is filled in incorrectly the report will not be sent and attention is drawn to the incomplete fields enabling the seafarer to correct any mistakes.

When the report has been filled out correctly the report is sent to Sound VTS, greeting the seafarer with a successful submission page.

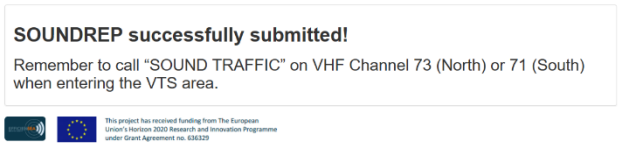

Figure 11. Successful submission of report to Sound VTS

Assuming the seafarers do not clear their browser cache before visiting www.soundvts.org again to report, the static information such as ship name, call sign, MMSI number and IMO number are saved and do not need to be entered again.

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2.2.2 Web Form reports received at Sound VTS

When a seafarer successfully submit their report via the SOUNDREP Web Form an e-mail with the information is sent to contact@soundvts.org.

The e-mail is always presented and formatted in the same way which makes it easier for the VTSO to process the information and enter it into the SOUNDREP database.

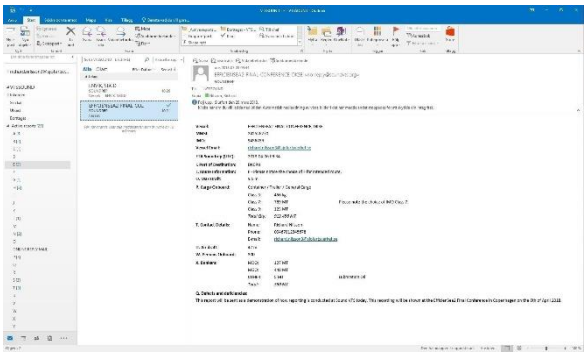

Figure 12. Web Form report received as e-mail

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2.2.3 Reading reports through VTS Admin

The VTS Admin web application was developed as a proof of concept for MMI.

The Web Form was further developed to not only send an e-mail to Sound VTS but at the same time sending the same report to a database. The seafarer is unaware of any change.

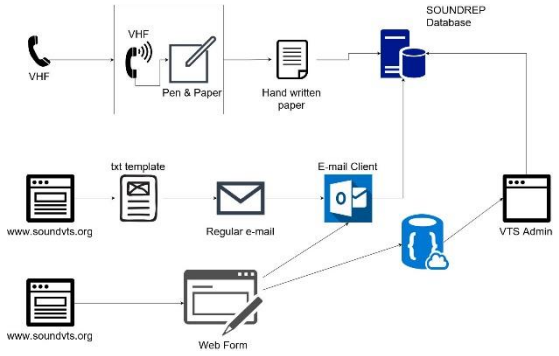

Figure 13. Reporting eco system

The report that is sent to the database is sent in JavaScript Object Notation (JSON) format. “JSON […] allows representing objects and collection of objects in a platform independent manner. Often it is preferred to transmit data […] [using JSON] because, compared to XML, it is a lighter notation and therefore allows transmitting the same amount of information in a more concise form.” (Buyya, Selvi and Vecchiola, 2013)

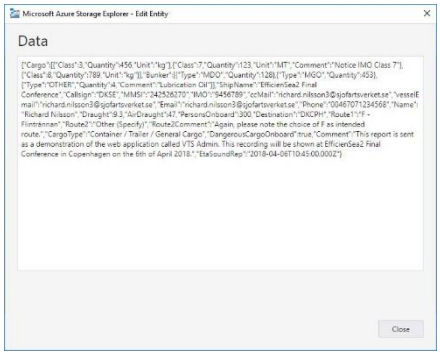

Figure 14. Repot in database that can be read by VTS Admin

This means that a report that is sent in JSON format could easily be read directly be a VTS monitoring system, which is feasible in the somewhat near future.

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The VTS Admin interface displays ship reports in a list, and can be sorted ascending or descending according to ETA Soundrep or by ShipName.

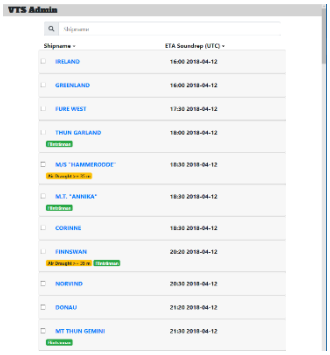

Figure 15. Reports displayed in VTS Admin

The VTS Admin interface has been customized to follow the same order as information is entered into the SOUNDREP database.

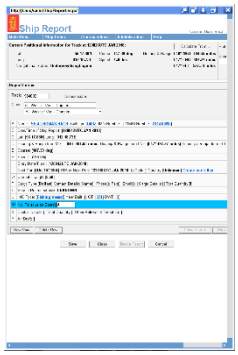

Figure 16. A report entered into the SOUNDREP database

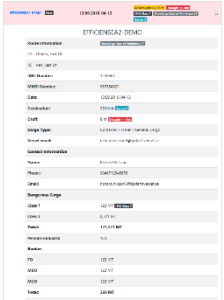

Figure 17. A report displayed in VTS Admin, information following the same order as SOUNDREP database

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As is visible in Figure 16, there are a number of color coded badges appearing for this demonstration report.

VTS Admin will highlight important information about the ship report. The important information is highlighted using color coded badges which use the same colors that are used internally at Sound VTS.

The badges are presented in the header before a report has been opened and also within the report so that important information is not missed by the VTSO.

The important information that is highlighted is:

- Maximum draught 8.0 meters or more (vessel is limited in their transit options)
- Air draught 35 meters or more (applicable for reporting to Copenhagen Airport)
- If the ship is bound for a destination within SOUNDREP Sector 1
- If the ship is bound for a destination within SOUNDREP Sector 2
- If the ship needs to pass East of Pinhättan lighthouse (vessels that transit through Lundåkrabukten with a maximum draught of more than 8.0 meters need to pass East of Pinhättan lighthouse)
- If Flinträннan has been selected as intended route (this is color coded to differentiate between vessels that intend to use the Drogden Channel)
- IMO Class 7 on board (radioactive cargo)

When a report has been read by the VTSO and entered into the SOUNDREP database, the report can be marked as processed in the VTS Admin interface. This will exclude the report from the unprocessed reports and the processed report will be sent to the bottom of the page. The processed report is marked as processed, but can still be opened and viewed again if the VTSO desires.

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3 Future of reporting

As was demonstrated at the Final Conference of EfficienSea2, it is not only the SOUNDREP Web Form that can populate the database that is read by VTS Admin. For the Final Conference Baltic Web was enabled to also send reports that populated the database.

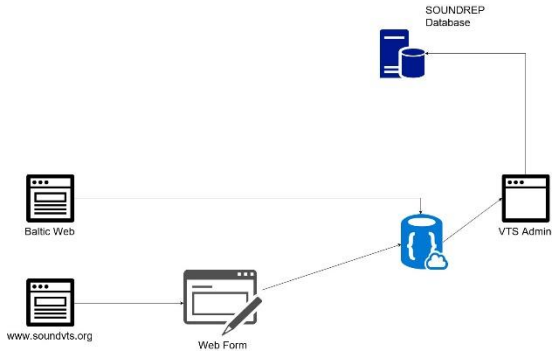

Figure 18. Baltic Web populating same database as SOUNDREP Web Form

The ideal solution for the future would be if a seafarer can send a report that is directly read by the VTS monitoring system without any interaction from the VTSO.

Hopefully, the ship report can in the future be sent in a more automated fashion, further reducing the administrative burden for the seafarer.

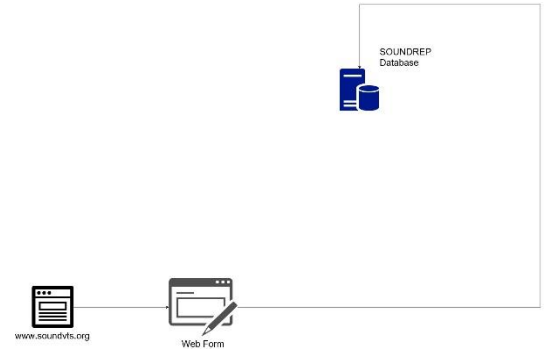

Figure 19. Web Form sending information directly to SOUNDREP database

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As food for thought the scenario depicted below could also be implemented.

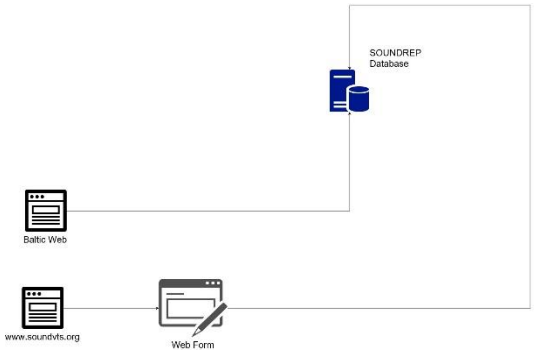

Figure 20. Baltic web and SOUNDREP Web Form sending reports directly to SOUNDREP database

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4 Reporting eXchange format (ReX)

The purpose of this chapter is to describe the ReX model and how a possible implementation of the ReX model can be implemented, using the BalticWeb prototype interface as an example platform.

This chapter assumes understanding of the document: “Vision for the Reporting eXchange format (ReX).pdf”, and general understanding of the Maritime Connectivity Platform (MCP).

4.1 Background

Any vessel sailing through international waters face a vast number of reporting requirements, defined by individual countries or regions according to their respective national legislation, and international requirements. This includes reports to the various Vessel Traffic Service Centres (VTS) passed along the route containing information on the cargo being transported and the ships' intended route, and also Ship Reporting Systems (SRS) with information on the crew of the vessels and other details which may be difficult to decipher from masters guides and other paper based or online sources which do not follow any standard layout.

The described model, ReX, aims at delivering a model for a reporting interface, providing the end user, the ships' captain or master mariner for instance, with a tool which automatically includes required information which must be sent to any VTS or SRS centre passed along the ships' route in national or international waters.

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4.2 Description of the ReX model

The “Reporting eXchange format” (ReX), is a model which describes the contents and defines the requirements of a report, either as an SRS report (Ship Reporting System), or VTS report (Vessel Traffic Service), and could possibly also include port reporting as the model matures. The model is projected to be open source.

The model is written in XML using XSD, and can from there be converted to different interpretable formats, all defining the same model.

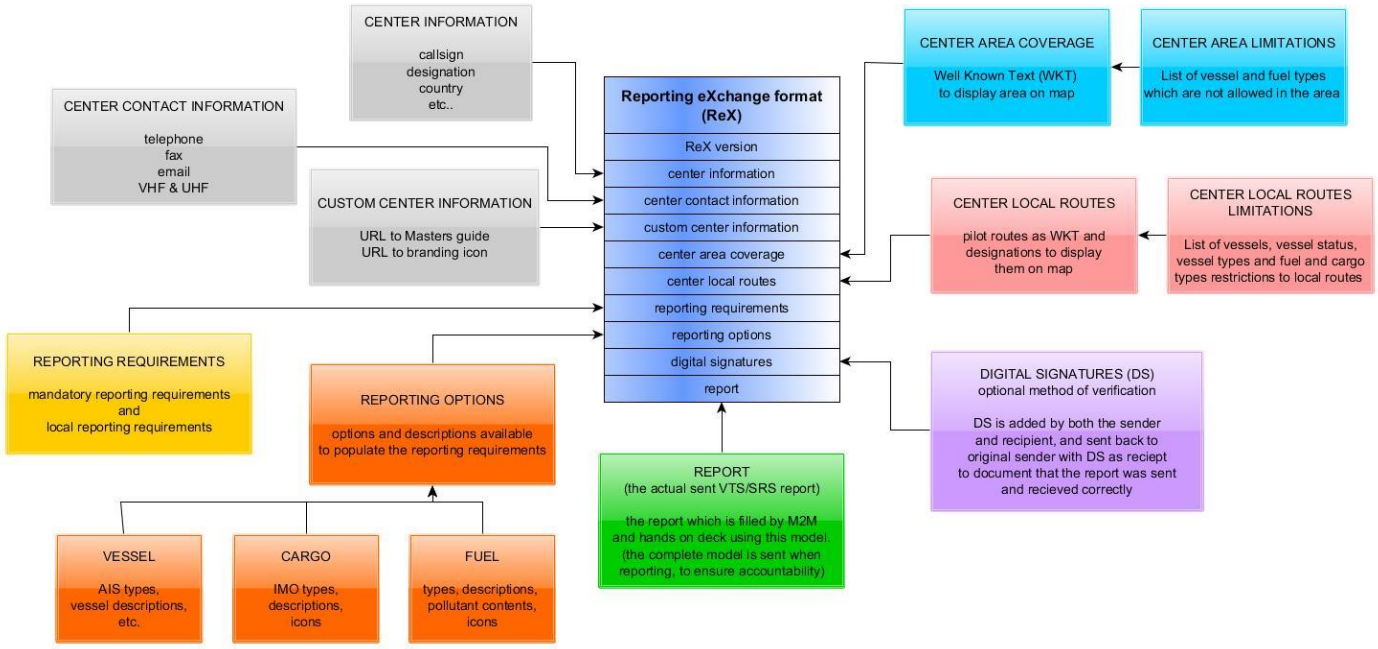

Figure 21. ReX overview

- The central blue box is the model container.
- Grey boxes in the diagram above contain all available information needed to contact and identify the reporting centre of that service instance.
- Yellow box contains the definitions of options to report, mandatory and optional.
- Orange boxes contain all the options and descriptions needed to report according to the settings in the yellow box.
- Light-blue boxes contains map overview and restrictions of the reporting area as a whole.
- Pink boxes contain map overview of the local routes to navigate and the limitations of each route.
- Purple box is optional, containing digital signatures to verify authenticity of sender and recipient.
- Green box is the actual report which is populated with the input, which is sent with the entire model as a report.

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The "reporting requirements" in the yellow box and the "reporting options" of the orange boxes work in tandem to populate an interface. This is possible by defining components as described in this document under "Usage of ReX in BalticWeb".

Once the "report" segment has been filled according to the "reporting requirement", the report, and the rest of the model in its entirety, is sent to the endpoint as described in the service specification, as found on the MCP.

4.3 ReX in the Maritime Connectivity Platform

The MCP, formerly known as the Maritime Cloud, is a service lookup platform which can return service designs by searching through the service descriptions. The service design of each of the search results can then be used to return the endpoints of each reporting service which hosts the ReX model.

The image below is a screenshot from the BalticWeb where 5 VTS/SRS reporting areas have been drawn on the map to give the user of the interface a simple overview, using the WKT (Well Known Text).

Figure 22. BalticWeb showing 5 VTS areas

There are no intellectual property rights considerations in regards to VTS and SRS, so any single player registering other VTS or SRS centres out of their legal responsibilities should probably be considered in a form of regulation. There may be other security and governing aspects which need to be reviewed.

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4.4 BalticWeb and MCP

The BalticWeb is a prototype interface platform to demonstrate services in the MCP and was created for the purpose of the EfficienSea2 project. The BalticWeb is split into two distinct areas, the frontend and the backend. The frontend covers the interface, meaning everything which is displayed on a screen, the text, menus, buttons and the map. The backend is responsible for retrieving data and the majority of the data manipulations in preparation to rendering the frontend for the user of the interface. BalticWeb can found at http://balticweb.e-navigation.net.

When the user is logged in on the MCP, services are made available to the user. The BalticWeb has buttons that enable or disable some of the services available on the MCP, which have been integrated into the frontend through the backend handling. Once the VTS & SRS service has been activated, moving the map around will trigger the backend of the BalticWeb to retrieve any VTS and SRS centres located within the area of the map, as can be seen in the image above.

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4.5 Usage of ReX in BalticWeb

Zooming in on a reporting area activates the callsign property of the area to be displayed on the map, in this example "SOUNDREP" can be seen. Although all properties are already available to the user, information is visualized when appropriate to avoid cluttering the interface.

Figure 23. SOUNDREP in BalticWeb

Information made available to the user can have a direct benefit when using design strategies to enhance user experience. In the example image to the right, simplified contact information is made available to the user by simply clicking or tapping on a VTS area drawn on the map. This feature alone is already a massive upgrade when comparing to VTS centre contact information availability today.

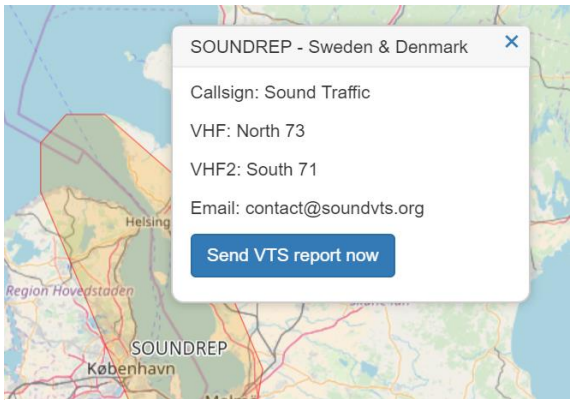

Figure 24. SOUNDREP Contact Information

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Figure 25. SOUNDREP reporting interface in BalticWeb

The actual reporting interface is populated directly from the ReX model, using the "reporting requirements" to fill the interface with the available "reporting options". Validation is defined by the XSD, to ensure correct data input.

The reporting options are displayed in a manner which is interpretable and customizable by a UX designer who does not necessarily have to learn what all the different technical names and standards or requirements are, while also giving freedom of creativity to allow different designs or user interface (UI) versions to be created. This allows for a variety of interface layouts with different components to be created, which can be a powerful tool to allow any seafarer who must send reports, to decide themselves which UI they find easier to use, or by mandate of their shipping company, to use a specific reporting interface layout.

One of the core advantages of using the ReX model is the ability to add and remove reporting options without having to redesign the entire frontend or having to invest time to educate developers to have intimate knowledge of VTS and SRS reporting requirements.

4.6 Security aspects, validation of authenticity and changes to requirements

Once a report has been filled and validated by the frontend, a digital certificate can be added by the captain as a signature of authenticity before it is sent to the respective reporting centre. Upon receiving the report, the reporting centre can add their own digital signature to the same report and send it back to the sender, so that the captain aboard the vessel gets confirmation of reception, and a digital signature to verify that it was the correct recipient.

Authorization to send the report can be controlled by the MCP. This would be as simple as using the identity provider as a guarantee of identity, or by adding a filter at the receiving end to flag reports which do not contain digital signatures or unknown digital signatures. The general idea is for reporting centres to always accept reports, including incorrectly filled reports and reports from unknown sources, because human error should be anticipated. An empty or incomplete report is still better than no report.

Using the ReX and the MCP, changes to reporting requirements can be effectuated much faster than today, where shipping companies, vessel owners and navigators need to be updated somehow of new requirements, but using the ReX, the moment it is updated, any

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interface will use the new model immediately. This does require the interface to be prepared for any additions, but does not require the captain or person responsible of reporting to have prior knowledge of the changes.

4.7 Benefits of defining area and pilot route limitations

The ReX supports definitions of limitations of reporting areas, and limitations of pilot routes, which can possibly add to safer navigation of reporting areas. Many reporting areas include traffic separation schemas, maximum draught limitations, maximum air draught limitations, and can include restriction of access to certain dangerous cargo types, and other restrictions. By adding these in the ReX, a report interface can also be used as a guide to navigation, for instance if person attempts to report maximum draught of 4.6 meters, but the specific pilot route which has been selected has a maximum depth of 3.8 meters, the person can be warned in the interface that selecting this route can have navigational safety concerns which should be addressed.

4.8 Changes and updates to the ReX

Updating the ReX for the area can be done relatively easy by VTS operators, so any permanent changes to safety of navigation such as seabed changes, traffic changes, fuel type and cargo type restrictions etc. can be described as limitations and implemented with immediate effect through the MCP.

4.9 Report sharing

A report can be shared between reporting centres who choose to have a collaboration amongst themselves, whether that be the maritime authorities of Brazil and South Africa having a report sharing agreement, or other countries or groups of countries. This can be done in a variety of ways, but ultimately, a report using the ReX format will be interchangeable without having to specify metadata describing sender, recipient, time of report etc., because it is all already inside the ReX model. This allows for a simple and traceable sharing option to be met.

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4.10 Machine to Machine data collection potential using ReX

The ReX model was designed with the aim of being flexible in order to be able to incorporate several external data sources such as WKT, RTZ, AIS and other automatable data sources. In the BalticWeb, AIS and RTZ have been implemented to aid the user by pre-filling pertinent required information. There is a potential to include data from existing external sources, such as information of dangerous cargo from SafeSeaNet or fuel monitoring hardware interfaced to deliver mandatory fuel reporting data. This can be done without having to reinvent technology or legislation.

Figure 26. ETA to VTS area automatically entered from route schedule

In the BalticWeb reporting user interface (UI), RTZ has been implemented to aid in filling the Expected Time of Arrival (ETA) at the reporting area, as displayed in the image to the right.

The RTZ has arrival times at waypoints, which are analysed to find the first waypoint placed inside the VTS reporting area. The arrival time is extracted and converted to a human readable time and date, which is represented in a datepicker which allows manipulation to manually override the ETA. It is essential that human interaction can supersede automated inputs.

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4.11 Immediate improvements and advantages to using the ReX on the MCP

Compared to existing reporting schemas found in the Baltic Sea region reporting centres websites, the ReX could possibly solve several problems of mariners and reporting centres when trying to send a report:

- Central and up to date contact information of the reporting centres
- Reduced radio chatter and misunderstandings during reporting
- Visual rendering of reporting areas on a map
- Simple UI to input data, meeting all requirements
- Reporting input data validation to ensure correct input
- Verification of sender and recipient identity using the MCP and digital certificates
- Documentation "paper trail" of sending and reception of report
- No metadata required to share or long term store reports
- Possibility of machine to machine data attribution using AIS, SSN, fuel monitoring etc.
- Possibility to easily update reporting requirements
- Maintenance responsibility remains at each individual reporting centre
- No central governance required - reporting centres control their own ReX
- Open source availability of the ReX
- Incorporation of other standards such as RTZ

(The predecessor of the ReX model, SOUNDREP reporting interface, is not considered in the above list)

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4.12 Potential worldwide adaptation scenario

The ReX is a prototype concept of a flexible reporting model, specifically created during the EfficienSea2 project, which is part of the European Union's Horizon 2020 Research and Innovation programme, and could be further developed to be implemented even worldwide, elevating the general standard of the current available reporting options, existing and non-existing.

This scenario is could be achieved by further development of the ReX model under open source, and developing a "blank slate" user interface under open source as well, using other open source technologies. The "blank slate" user interface could be forked or copied from a software version maintenance site as for instance GitHub, and then styled or modified to fit the branding desires of companies who wish to create their own reporting interface, which can handle custom machine to machine interfacing. It is also possible that any individual reporting centre can do the same, to serve a default platform to report from, using their own style and branding.

Alternatively, an organization such as IMO could cater a globally accessible interface using their version of the "blank slate" user interface, to provide a free and trusted reporting interface, worldwide, which only requires VTS and SRS centres to adopt the ReX and register it as their instance of a service on the MCP.

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5 Reference list

NEW MANDATORY SHIP REPORTING SYSTEM "IN THE SOUND BETWEEN DENMARK AND SWEDEN" (SOUNDREP). (2010). [ebook] International Maritime Organization, p.1. Available at: http://www.sjofartsverket.se/pages/101961/MSC.314(88).pdf [Accessed 13 Apr. 2018].

Buyya, R., Selvi, S. and Vecchiola, C. (2013). *Mastering cloud computing*. Waltham, MA: Morgan Kaufmann.

D3.4 - Service Specification for the SRS format Service version 1.0 available at: http://management.maritimecloud.net see specification for the SRS Format Service

Voyage Information Service Specification version 2.2 available at: http://management.maritimecloud.net see specification for the Voyage Information Service

Vision for the Reporting eXchange format (ReX).pdf available at: http://management.maritimecloud.net

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