MONALISA 2.0 – Sub-Activity 1.5

Shore-based Deep Sea Assistance

Concept of operation and standard operating procedures for Shore-based Deep Sea Assistance

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### Document Status

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1 Introduction

1.1 Scope and purpose

This document reports “Pilot SOPs and Guidelines” for the Sub-Activity 1.5 in Activity 1 of the MONALISA 2.0 project. The report outlines a concept of operation for the Shore-based Deep Sea Assistance. Further, the report describes high-level tasks, which constitute the base for operating procedures.

The report starts with a description of the Sea Traffic Management (STM) concept and the operational services that support Shore-based Deep Sea Assistance, followed by an operational analysis, description of decision support tools, and high level operating procedures. This is the final version of the report.

1.2 Background

The Sea Traffic Management (STM) concept has been introduced by the MONALISA 2.0 project. An overview description of STM can be found in the document “Sea Traffic Management – a Holistic View” (STM, 2015).

Within STM, four enabling strategic concepts have been identified as crucial for reaching the target values. These are:

- **Port Collaborative Decision Making (Port CDM)**, in which the process for arrivals and departures is made more efficient through information sharing, common situational awareness and improved processes;
- **Strategic Voyage Management (SVM)**, which deals with route planning, route exchange and route optimisation before the voyage has started;
- **Dynamic Voyage Management (DVM)** which deals with route planning, route exchange and route optimisation whilst the ship is on its way;
- **Flow Management (FM)**, which includes services that will support both land organisations and ships in optimising overall traffic flow through areas of dense traffic and areas with particular navigational challenges.

These are all enabled by:

- Information sharing by **Sea System Wide Information Management (Sea SWIM)**, which has the intention of being a common framework for information sharing and service distribution for maritime activities.

This document focuses on the definition and operational services included in the Flow Management concept.
1.3 Study logic and methods used

The current situation is based on literature study of pilot services and navigation assistance, followed by a field observation. This is reported in “Prerequisites for Shore-based Deep Sea Assistance”.

The operational analysis is inspired by the Unified Profile for DoDAF/MODAF (UPDM) that provides an industry standard UML/SysML representation of DoDAF/MODAF architecture artefacts. One of the outputs from the operational analysis is the need for information together with information exchange requirements between ship and shore during navigation assistance. A high-level task analysis provides the basis for operational procedures that are then further tested and developed using advanced ship simulators. The first results of the operational analysis and operating procedures are reported in this document.

The Figure 1 below depicts the overall study logic of Sub Activity 1.5.

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**Figure 1**: Study logic for Sub-Activity 1.5 making use of Activity 2 and other Sub-Activities together with field observations.
1.4 Structure of report

Based on the study logic and methods used, this report is organised as followed:

**Chapter 1** is this introduction defining scope and purpose, giving a background and lists of abbreviation used in the report. It also provides study logic and briefly discusses methods used.

**Chapter 2** gives an overview of the STM and its strategic concepts defined in Activity 2.

**Chapter 3** reports an operational analysis and describes the concept of operation.

**Chapter 4** contains descriptions of some applicable decision support solutions.

**Chapter 5** gives a set of high level operational procedures, both for the ship using the service and the shore based service provider.

1.5 List of abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>AIS</td>
<td>Automatic Identification System</td>
</tr>
<tr>
<td>CDM</td>
<td>Collaborative Decision Making</td>
</tr>
<tr>
<td>COG</td>
<td>Course over Ground</td>
</tr>
<tr>
<td>COLREG</td>
<td>International Regulation for Preventing Collisions at Sea</td>
</tr>
<tr>
<td>DPP</td>
<td>Dynamic Position Predictor</td>
</tr>
<tr>
<td>DVM</td>
<td>Dynamic Voyage Management</td>
</tr>
<tr>
<td>ECDIS</td>
<td>Electronic Chart Display and Information System</td>
</tr>
<tr>
<td>ENC</td>
<td>Electronic Nautical Charts</td>
</tr>
<tr>
<td>ETA</td>
<td>Estimated Time of Arrival</td>
</tr>
<tr>
<td>ETD</td>
<td>Estimated Time of Departure</td>
</tr>
<tr>
<td>FM</td>
<td>Flow Management</td>
</tr>
<tr>
<td>FPT</td>
<td>Flow Point</td>
</tr>
<tr>
<td>GPS</td>
<td>Global Positioning System</td>
</tr>
<tr>
<td>MSI</td>
<td>Maritime Safety Information</td>
</tr>
<tr>
<td>MSP</td>
<td>Maritime Special Planning</td>
</tr>
<tr>
<td>NAS</td>
<td>Navigational Assistance Service</td>
</tr>
<tr>
<td>NCA</td>
<td>National Competence Authority</td>
</tr>
<tr>
<td>NM</td>
<td>Nautical Mile</td>
</tr>
<tr>
<td>NtM</td>
<td>Notice to Mariners</td>
</tr>
<tr>
<td>NUC</td>
<td>Not Under Command</td>
</tr>
<tr>
<td>OOW</td>
<td>Officer on Watch</td>
</tr>
<tr>
<td>RD</td>
<td>Reference Document</td>
</tr>
<tr>
<td>SOG</td>
<td>Speed over Ground</td>
</tr>
<tr>
<td>SAR</td>
<td>Search and Rescue</td>
</tr>
<tr>
<td>SBNAS</td>
<td>Shore Based Navigation Assistance Service</td>
</tr>
<tr>
<td>SRS</td>
<td>Ship Reporting System</td>
</tr>
<tr>
<td>STM</td>
<td>Sea Traffic Management</td>
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MONALISA 2.0 – SHORE-BASED DEEP SEA ASSISTANCE
<table>
<thead>
<tr>
<th>Acronym</th>
<th>Full Form</th>
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<tbody>
<tr>
<td>STCW</td>
<td>International Convention on Standards of Training, Certification and Watchkeeping</td>
</tr>
<tr>
<td>SVM</td>
<td>Strategic Voyage Management</td>
</tr>
<tr>
<td>SWIM</td>
<td>System Wide Information Management</td>
</tr>
<tr>
<td>TBD</td>
<td>To Be Determined</td>
</tr>
<tr>
<td>TOS</td>
<td>Traffic Organisation Service</td>
</tr>
<tr>
<td>TSS</td>
<td>Traffic Separation Schemes</td>
</tr>
<tr>
<td>UCD</td>
<td>User Center Design</td>
</tr>
<tr>
<td>UNCLOS</td>
<td>United Nations Convention On The Law Of The Sea</td>
</tr>
<tr>
<td>VTS</td>
<td>Vessel Traffic Service</td>
</tr>
<tr>
<td>WOL</td>
<td>Wheel Over Line</td>
</tr>
<tr>
<td>WOP</td>
<td>Wheel Over Position</td>
</tr>
<tr>
<td>WP</td>
<td>Work Package</td>
</tr>
<tr>
<td>WPT</td>
<td>Waypoint</td>
</tr>
<tr>
<td>XTD</td>
<td>Cross Track Distance</td>
</tr>
</tbody>
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# 1.6 Terms and definitions

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waypoint</td>
<td>Reference point on the route</td>
</tr>
<tr>
<td>Flowpoint</td>
<td>Key waypoint for which ETA is used in Traffic Coordination</td>
</tr>
<tr>
<td>Route</td>
<td>The intended horizontal direction of travel with respect to the earth. The route is described in IEC 61174 by route information, route geometry and route schedule</td>
</tr>
<tr>
<td>Route plan</td>
<td>Detail plan of the geometrical route together with route schedule.</td>
</tr>
<tr>
<td>Voyage plan</td>
<td>Route plan together with additional voyage information regarding crew, cargo, environmental and legal aspects.</td>
</tr>
<tr>
<td>Route exchange</td>
<td>Next couple of WPT along the ships planned route are broadcast by means of AIS to vessels in line of sight</td>
</tr>
<tr>
<td>Intended route</td>
<td>A route that has reached status 7</td>
</tr>
<tr>
<td>Suggested route plan</td>
<td>A proposed change to the intended geometrical route</td>
</tr>
<tr>
<td>Suggested route schedule</td>
<td>A proposed change to the intended route schedule</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type of geographical area</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>SBNAS area</td>
<td>A geographical area where Shore Based Navigational Assistance services can be provided</td>
</tr>
<tr>
<td></td>
<td>Provided by a shore based organisation</td>
</tr>
<tr>
<td>Critical area</td>
<td>An high risk area where ship traffic is allowed, but increase safety measures are taken as more stringent safety margins may apply</td>
</tr>
<tr>
<td></td>
<td>Restricted area, Environmental sensitive, Traffic congestions or high traffic density</td>
</tr>
<tr>
<td>Static No Go Area</td>
<td>A static (over time and in space) area where ship traffic is fully or partially restricted</td>
</tr>
<tr>
<td>Dynamic No Go Area</td>
<td>A dynamic (in time and space) area where ship traffic is fully or partially restricted</td>
</tr>
<tr>
<td></td>
<td>This can be an environmental sensitive area during a specific period of time and for certain ship traffic</td>
</tr>
<tr>
<td>VTS area</td>
<td>An area where VTS is available to all or some specific vessels</td>
</tr>
<tr>
<td></td>
<td>The VTS has three types of services: Information, Navigation assistance and Traffic organisation</td>
</tr>
</tbody>
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1.7 List of reference documents


(ACCSEAS) www.accseas.eu
2 Sea traffic management

This section provides a general description of STM as defined in Activity 2 of this project. The objective is to give an overview of those parts in the overall STM concept that are applicable for Shore-based Deep Sea Assistance.

2.1 Background

The introduction of STM puts a focus on enabling safe, sustainable, and efficient sea transports. STM is a response to the need to increase efficiency in operations within and between ports. The concept takes a holistic approach to services putting the berth-to-berth voyage in focus and uses that as a core element for process optimisation, actors and stakeholder interaction and information sharing. An enhanced sharing of information ship-to-ship, ship-to-shore, and shore-to-shore is also an important enabler for increased safety during sea transports. The improved safety is based on an enhanced situational awareness and right information at the right time. Shore-based organisations can contribute considerably by adding valuable information and advice based on:

- An enhanced traffic image which can be used to detect potential collisions, groundings and traffic congestions alerting vessels; and
- Updated regional information and effective way of informing ships about potential hazards.

All this is enabled by allowing information owners to share real-time information to preferred recipients as well as allowing information users to access necessary, real-time based data streams for their purpose.

The scope of STM includes private, mandatory, and public service opportunities along the voyage, berth-to-berth. Further, STM relates to existing practices and initiatives within e-navigation, e-maritime, and the collaborative port. As outlined above, the STM concept is defined by its operational services, which involves already existing processes and services and in some cases new defined services by:

- enhancing existing services; and
- proposing and validating new innovative services.
Within STM four enabling strategic concepts have been identified as crucial for reaching the target values. These are:

- **Port Collaborative Decision Making (Port CDM)**, in which the process for arrivals and departures is made more efficient through information sharing, common situational awareness and improved processes;
- **Strategic Voyage Management (SVM)**, which deals with route planning, route exchange and route optimisation before the voyage has started;
- **Dynamic Voyage Management (DVM)** which deals with route planning, route exchange and route optimisation whilst the ship is on its way;
- **Flow Management (FM)**, which includes services that will support both land organisations and ships in optimising overall traffic flow through areas of dense traffic and areas particular navigational challenges.

These are all enabled by:

- Information sharing by **Sea System Wide Information Management (Sea SWIM)**, which has the intention of being a common framework for information sharing and service distribution for maritime activities.

In Deep Sea Shore-Based Assistance, operational services within the FM and DVM concepts are especially used. These two concepts are further described below.

### 2.2 Flow Management

FM focuses on optimising the overall maritime traffic flow within a specific geographical region. The knowledge of all or nearly all ship’s route plans and schedules within a specific region gives rise to the possibility of coordinating the traffic by the use of:

- **Dynamic No-Go-Areas**, representing areas that should be avoided during certain time periods or by certain ships, due to environmental or navigational aspects. This will be accounted for already in the voyage-planning phase.

- **Dynamic separation**, which can be performed in two ways:
  - lateral dynamic separation, which may be used to separate in/out-bound but also in overtaking situations
  - longitudinal dynamic separation (i.e. when overtaking is not safe or practical) separating traffic in the longitude plane. This can be performed already in the voyage-planning phase.

- **Temporal separation**, representing a time window for the ship in order to reach an optimised ETA in port, also considering areas with traffic congestions. This can be accounted for in the voyage planning process and will be a continually updated.
FM services are provided by authorities or commercial service providers appointed by the National Competent Authority (NCA), and could for instance be:

- Port Control;
- Vessel Traffic Service (VTS); or
- Other shore-based service provider.

The two first organisations already exist today, while the last one may be introduced by the STM concept. FM services are provided within a specific defined geographical area. Below a summary of the FM services are given:

- **Establish a regional traffic image and route plan database**, which continuously updates the real time traffic and stores the ship’s intended routes and schedules;
- **Enhanced shore-based monitoring in critical areas**, which uses the known routes and schedules to monitor ship traffic in specific areas, which could be environmental sensitive, or have high traffic density or be navigationally challenging;
- **Area management**, which collects, manages and distributes maritime information, and manages dynamic no-go-areas;
- **Flow optimisation**, which optimises the overall traffic flow within congested areas; and
- **Traffic Pattern Analysis**, which use statistical information in order to optimises future traffic flow in congested areas.

Note that the SeaSWIM concept guarantees the seamless transition of information along the ship’s route.

The most relevant operational services for Deep Sea Shore-Based Assistance are further described below:

**Enhanced shore-based monitoring in critical areas**, during the monitoring phase, the Officer on Watch (OOW) continuously monitors the ship’s track with respect to the intended track, navigational hazards, and other traffic. In more restricted waters or were the traffic is congested, increased manning could be a measure to cope with the increased workload. One way of solving this could also be to let a shore-based operator to follow all STM compliant ships with respect to their respective intended routes and schedules monitored within a certain area.

**Area management**, the exchange of route information and dynamic geo-locations, open up new possibilities for area management. A geographical area may be sensitive during specific periods of times and can dynamically be classified as a restricted area or no-go-area. This type of areas may be considered already during the planning phase,
when using Route Optimisation or Route Validation service, see further §2.3. This area will also be visible on-board to the OOW by the normal ECDIS system. Maritime Safety Information (MSI) and other safety related information are geo-spatial information and can also be transmitted and presented by the ship's ECDIS. This has also been investigated in the EU-INTEREG project ACCSEAS, (ACCSEAS).

**Flow optimisation**, the Route Optimisation service performed in DVM could also consider the traffic in congested waters and port entrances, in order to optimise the overall voyage. During the voyage-planning phase, the Flow Optimisation service can separate inbound traffic from outbound traffic and resolving unnecessary traffic congestions. Also a time slot separation between ships close to the departing port could be included. During the execution of the voyage, the continuous route optimisation may include traffic coordination in nearby congested areas using time slots. The practical implementation will be ETA driven using key waypoints (WPT) at strategic positions along the route, here denoted Flowpoint (FPT). FPT will be part of the route plan. The shore-based operator has two means to propose route changes:

- Route suggestion, which proposes a geographical route deviation; and
- Schedule suggestion, which proposes new ETA to FPT and to the port.

### 2.3 Dynamic Voyage Management

If a ship's route plan and schedule are exchanged and made available for different actors and stakeholders this would open up for new possible services:

- **Single reporting area**, the objective is to perform ship reporting once, which is then distributed to all stakeholders along the route. Ship information is transmitted together with route information.

- **Route cross-checking**, which checks the planned route with respect to regional information;

- **Route optimisation**, which optimises the route with respect to environmental, port, regional and traffic parameters and constraints;

- **Shore-based Deep Sea Assistance**, which gives navigational support outside the VTS area – the subject for this report; and

- **Routes exchange** ship to ship, which increases the situational awareness in traffic situations.

Hence, the DVM concept provides improved situational awareness through enhanced traffic information by route exchange ship-to-ship, ship-to-shore and opens up new possibilities for assistance of vessels en-route. The optimisation creates the prerequisite for "just-in-time" operations arriving and departing from ports. Below the above listed operational services are further described.
Single reporting could potentially be implemented as a large Ship Reporting System (SRS). The objective is to perform ship reporting only once, which is then distributed to all VTS and other nominated stakeholders along the route. Ship information is transmitted together with route information.

Route Cross-checking service, the intended voyage plan is sent to a shore based service provider for validation and checking. The validation can be done before the ship departure or before arrival at a certain geographical area. The validation control includes, but not limited to, primarily an Under Keel Clearance (UKC) and air draught check and such as no violation of static no-go areas, MSI and compliance with mandatory routeing. No optimisation service as such is included in the route validation.

Route Optimisation services, the services are voluntary services provided by different private or public service providers with intention to optimise the route regarding to e.g. weather, ice conditions, MSI, distance, speed, traffic congestion and bathymetric conditions. The route optimisation is an iterative process and can be performed both pre-departure and continuously en-route as basis and conditions changes. Some of these services are available today and optimisation is carried out on-board as well as by service providers ashore. However, the route exchange provides new and more effective possibilities for this optimisation.

Shore-based Deep Sea Assistance service, in addition to enhanced monitoring, passive and automatic surveillance for detecting deviation from intended route, provided by a shore-based service provider within its SIR area as a voluntary navigation assistance, the subject for this report.

Enhanced situational awareness by Route Exchange service, introducing route exchange between ship-to-ship, vessels will also know the intentions of vessels within AIS line-of-sight. This service was also investigated in the EU-INTEREG project ACCSEAS, (ACCSEAS). Nothing in the current “navigational process” will be changed. The master is still responsible and COLREGs are always in force. The route exchange will solely introduce a new tool that helps the OOW to plan ahead, foresee possible dangerous situations and reduce route detours due to traffic conditions.
3 Operational analysis

This section performs an operational analysis of the Deep Sea Shore-Based Assistance. Firstly, the service is defined and its scope determined. Secondly, an operational analysis of navigation under the assistance from the shore side is performed. This analysis is described in the view of the services defined in STM. The analysis is inspired of Unified Profile for DoDAF/MODAF (UPDM) where an operational view identifies the needs required to accomplish a specific operation. Using this view, tasks, operational elements and exchange of information may be identified.

3.1 Operational context

3.1.1 Definition and scope

The background, current situation and scope of pilot and navigation assistance have been given in [RD1], which constitutes the literature study and field observations depicted in Figure 1. The formal name of this operational service is “Shore-based Deep Sea Assistance”. Below follows a discussion of the name, definition, and scope and of this service.

“Deep Sea”: This implies that the area of operation is at Deep Sea. However, the definition of Deep Sea in [RD2] is the depth layer below the thermocline. In our context, this implies an operational area on deep water probably outside the continental shelf. The original idea behind this service was to give assistance in coastal waters and in geographical areas like the North Sea and the Baltic Sea.

“Shore-Based”: This implies that the service provider is based on shore and is communicating its advice and guidance to the ship by electronic means.

“Assistance”: implies advice and guidance to the ship in navigation. Today, Navigation Assistance Service (NAS) exists as a possible Vessel Traffic Service (VTS), (IMO, 1997). Further, “assistance” implies that this serves should not be mixed with compulsory pilot service that exists in several fairways and port entrances.

In (DMA), the following two definitions are found:

“Deep-sea pilotage: Pilotage outside the territorial waters of a country” and “Land-based pilotage: Pilotage carried out by means of communication from ashore.”

To conclude; “Deep Sea” is a suitable term if the area of operation includes coastal waters and geographical areas as the North Sea and the Baltic Sea. Just “Assistance” does not explain what type of assistance is to be provided. A more generic term could be “Shore Based Navigation Assistance Service” here after denoted SBNAS throughout in this document.
As mentioned above the Navigational Assistance is already used in the VTS context. A VTS can be divided into two main types; port VTS or coastal VTS, (IALA, 2002). A port VTS mainly focus on traffic to and from one or several ports, while a coastal VTS is mainly focusing on traffic passing a geographical area. It should be noted that a VTS do not need to be exclusively defined as a port or a coastal VTS. The purpose of VTS today is to provide active monitoring, information service, traffic organisation, and navigational assistance for vessels in confined and busy waters. Hence, a VTS can be operated in one or two of three different services:

- Information;
- Navigation assistance; or
- Traffic organisation.

In this context Navigation assistance and Traffic organisation are the most relevant issue for further discussion:

Navigational Assistance Service (NAS) is "a service to assist on-board navigation decision-making and to monitor its effects, especially in difficult navigational or meteorological circumstance or in case of defect or deficiencies" (IMO, 1997). This service may include:

- ship’s course and speed made good;
- ship’s position relative to the fairway axis and waypoints;
- ship’s position, identification and intensions of surrounding traffic; and
- warning of dangers.

Traffic Organisation Service (TOIS) is "a service to prevent the development of dangerous maritime traffic situations and to provide for the safe and efficient movement of vessels" (IMO, 1997). A traffic organisation service is concerned with, e.g.:

- Forward planning of vessel movements;
- Congestion and dangerous situations;
- The movement of special transports;
- Traffic clearance systems;
- VTS sailing plans; and
- Routes to be followed.

The second conclusion is that SBAS is a service outside the VTS area, while NAS and TOS are performed within the VTS area of operation. This is also in line with (DMA, xxx) definition of Deep Sea as being outside territorial waters. However, the SBAS concept described in §3.2 may be the practical implementation of NAS for STM compliant ships.
SBAS is a concept for shore based navigation assistance executed in well-defined geographical areas utilising STM information and operational services.

SBAS nor NAS should not be mixed with compulsory Pilotage Service.

In figure 2 below, an operational picture is given. The different areas of operation are illustrated in the figure.

Figure 2 Definition of areas of operation for SBNAS, NAS and Pilot Service depicting two different ships. One is following a coastal route transiting the area and another ship just entered the VTS area.

3.1.2 Operational context description

The operational context graph depicted in Figure 3 illustrates three ships navigating in a coastal region. One ship is transiting, one is leaving a port and one ship has made a landfall and approaches port. In this graph, the transiting vessel is new to this area and has requested shore based navigation assistance when passing through the region. A request of assistance may be based on the:

- Particular ships navigation policy under current conditions;
- Shipping company’s navigation policy;
- Ship’s crew lack experience of the area
- Cargo owner requirement; and
- Insurance requirements.
With respect to the STM concept, the following actors are identified as part of this service:

- **Shore-based operator**, this is the operator performing the shore based assistance. If the area of operation is located within a VTS area, the service is performed by a VTS operator within its normal NAS.

- **STM compliant ships**, having the relevant STM equipment and procedures implemented on board, so it can make full use of the STM concept. In practice meaning the functionality of exchanging a segment of its route and schedule plan with the shore based operator.

- **STM non-compliant ships**, a ship(s) that is/are not participating in the STM process or does not have the relevant STM compliant equipment.

Hence, the ship needs to be a STM compliant ship if it wants to utilise a STM shore based navigation assistance. The assistance is provided from a shore based operator, whom has access to:

- STM services and information;
- enhanced traffic image including targets and planned routes and schedules; and
- local environmental information.

The assistance is given at two different time scales:

- Tactical navigation – current navigation; and
- Look ahead – updating the plan.

Further, the assistance can be divided into two levels:

- **Passive**, which is basically the Enhanced Shore-based service described in §2.2, but are specifically order by the ship, and

- **Active**, which is detailed in the following of this report.
The passive level could be selected in geographical areas that is not as navigational demanding, but still require more of the ship’s crew than open sea navigation. The Figure 3 below is an operational context graph for SBNAS.

**Figure 3** Operational picture capturing the context, showing a shore based service provider assisting one of the ships, which route is visualised, another STM ship in blue and a third vessel not participating in the STM concept.
### 3.1.3 Operational parameter

Based on the above contextual description the bases of the operational analysis may be laid down, identifying the operational parameters, see table 1 below.

<table>
<thead>
<tr>
<th>Operational parameter</th>
<th>Description in this context</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operational environment</strong></td>
<td>The service will only performed within certain limiting levels of environmental parameters as:</td>
</tr>
<tr>
<td></td>
<td>Ice coverage</td>
</tr>
<tr>
<td></td>
<td>Risk of icing</td>
</tr>
<tr>
<td></td>
<td>Wind</td>
</tr>
<tr>
<td></td>
<td>Sea state</td>
</tr>
<tr>
<td></td>
<td>Current</td>
</tr>
<tr>
<td></td>
<td>Tidal stream</td>
</tr>
<tr>
<td></td>
<td>Visibility</td>
</tr>
<tr>
<td></td>
<td>The limiting levels are geographical area and ship specific</td>
</tr>
<tr>
<td><strong>Operational geographical area</strong></td>
<td>Coastal regions outside VTS areas (outside territorial waters</td>
</tr>
<tr>
<td></td>
<td>Regional seas like e.g. the Baltic Sea</td>
</tr>
<tr>
<td></td>
<td>VTS area utilising NAS</td>
</tr>
<tr>
<td><strong>Operational nodes</strong></td>
<td>Shore based service provider</td>
</tr>
<tr>
<td></td>
<td>VTS</td>
</tr>
<tr>
<td></td>
<td>STM compliant ship using the service</td>
</tr>
<tr>
<td></td>
<td>STM ships not compliant using the service</td>
</tr>
<tr>
<td></td>
<td>Non STM compliant ships/vessels</td>
</tr>
<tr>
<td></td>
<td>Ports</td>
</tr>
<tr>
<td><strong>Operational element</strong></td>
<td>Exchanged information, see further §3.4</td>
</tr>
<tr>
<td><strong>Actors</strong></td>
<td>Ship’s master for the STM ship using the service</td>
</tr>
<tr>
<td></td>
<td>Ship’s OOW for the STM ship using the service</td>
</tr>
<tr>
<td></td>
<td>Shore based service operator</td>
</tr>
<tr>
<td></td>
<td>VTS operator</td>
</tr>
<tr>
<td></td>
<td>Ship’s master for the STM ship not using the service</td>
</tr>
<tr>
<td></td>
<td>Ship’s OOW for the STM ship not using the service</td>
</tr>
<tr>
<td></td>
<td>Ship’s master for the STM non-compliant ship/vessel</td>
</tr>
<tr>
<td></td>
<td>Ship’s OOW for the STM non-compliant ship/vessel</td>
</tr>
<tr>
<td><strong>Stakeholders</strong></td>
<td>Port State NCA</td>
</tr>
<tr>
<td></td>
<td>Coastal State NCA</td>
</tr>
<tr>
<td></td>
<td>Shipping company</td>
</tr>
<tr>
<td></td>
<td>Insurance company</td>
</tr>
<tr>
<td></td>
<td>Cargo owner</td>
</tr>
</tbody>
</table>

| Table 1 | Operational parameters identified based on the operational description. |
3.2 Operational description of concept

Based on the operational context and operational parameters listed in the previous paragraph SBNAS are described in the context of STM. SBNAS should only be provided within a certain well defined geographical area. There are some conditions that have to be fulfilled in order to be able to provide the services:

- The existing traffic image consisting of AIS targets;
- Enhanced monitoring service is active by utilising an enhanced traffic image; and
- Voice and text communication are supported.

The service can be divided into five distinct operational phases:

**Phase 1: Planning**

This phase starts when the ship receives a Voyage Order from the shipping company. The detailed route planning is performed according the ship’s normal navigation policy and procedures. It is decided by the master (or shipping companies navigation policy) if SBNAS is to be used and for which leg.

In the communication with the shore service providers, SBNAS is ordered for a particular segment of the voyage. The ship sends additional information to the SBNAS service provider:

- Ship's particulars
- Ship's safety parameters; and
- Ship's manoeuvring characteristics.

The ship receives a proposed detailed voyage plan for this specific segment including a preliminary Navigation Plan. The route plan consists of:

- Legs, WPT, and FPT;
- Static and dynamic no-go-areas; and
- WO points or lines and turning radius.

The preliminary Navigation Plan is consists for each leg:

- Lighthouses, with characters and visual range;
- Aids-to-Navigation (AtoN);
- Dangers and distance to dangers;
- No Go areas
• Position fixing method;
• WO fixing method; and
• Turning radius.

The ship’s crew reviews the proposed segment of the voyage and the master approves the plan and combines it with the ship’s overall voyage plan. The total route is checked by the ship’s navigation system (i.e. ECDIS).

Further, one more possible input to the route planning process within the SBNAS area could be a ship risk index. Hence, for each ship using the service a risk calculation is performed by the master based on:
• Ship’s cargo, dangerous cargo;
• Master’s experience;
• Bridge crew experience;
• Expected weather and oceanographic conditions;
• Ship’s manoeuvring characteristics; and
• Port Control status.

The total risk value is also considering the geographical area with respect to:
• Navigation hazards;
• Traffic density;
• Environmental sensitive areas;
• MSP;
• Offshore activities;
• Operations conducted in the area; and
• Current and tidal water conditions.

When the ship is leaving port, the service provider receives ship reporting information via the Single Reporting Service and can update the SBNAS planning and schedule.

Phase 2: Outside the area:
In this phase the ship finally orders the SBNAS service in a handshake process confirming already communicated information.

Phase 3: Entering the area:
In this phase a voice or text connection between the ship and shore service provider is established. All transmitted and received information is confirmed.
Phase 4: Within the area:  
The service is executed:  
  - Enhanced monitoring is performed on all vessels within the region based on the traffic image and game plan (local route database)  
  - SBNAS is executed for one or several ships in the area

The different operational phases are illustrated in Figure 4 below.
Below the details of the active SBNAS is given. The service can further be divided into two modes of operation that are run in parallel:

- Tactical navigation mode; and
- Look ahead mode.

![Diagram of two modes: Tactical navigation and Look ahead](image)

**Figure 5** Illustration of the two modes Tactical navigation and Look ahead, which constitutes the SBNAS.

**Tactical navigation mode:**
In this mode, the ship has the intended route displayed on its navigational displays. It monitors its voyage and schedule according to normal operating procedures with the addition of procedures for the ship-to-shore communication. The OOW monitors all surrounding vessels based on visual -, Radar-, and AIS-observations. The OOW uses a Predictor or a Dynamic Predictor, see further §4, showing the ship’s predicted track taking into account wind, current and other effects on the ships course over ground. This gives an indication if the ship will deviate from the intended route.

On the shore side the operator has the ship’s intended route displayed together with all surrounding ship’s routes. Further, the operator has also visualised the ship’s no-go-areas. The shore service operator also monitors the ship’s position together with a predictor or a dynamic predictor. The SBNAS’s main function within this mode is monitoring of the ships progress together with monitoring the surrounding vessels. The ship-to-shore communication is crucial in this process and is based on the following means and methods:

- Voice communication, see further in §4.1
- Text communication, see further in §4.1
- Suggested route change, see further in §4.2
- Suggested route schedule change, see further §4.2
The shore-based operator may give the ship advice in the following situations:

- Ship is leaving its intended route and are running into danger
- Ship is not compliant to COLREG
- Safety messages which directly affects the ship’s safe passage
- Ship is approaching WO
- Confirms the ship’s new course after WO

**Look ahead:**
In this mode the shore service operator looks ahead along the ships route to detect any potential dangers or reasons for route change:

- Changes in weather and oceanographic conditions;
- Changes in the predicted traffic situations;
- Safety messages;
- Changes in navigation conditions, safety; and
- On-going operations like dredging, surveying, etc.

The shore side also has updated weather, tide, sea state and current information. The same methods for ship-shore communication are used as in the Tactical navigation mode:

- Voice communication;
- Text communication;
- Suggested route change; and
- Suggested route schedule change.

### 3.3 Other STM operational services supporting SBNAS

The STM concept supports SBNAS mainly with the following STM services:

- Single reporting;
- Area management;
- Enhanced monitoring; and
- Route Optimisation.
The information exchange between the services is depicted in Figure 6 below.

![Diagram](image)

**Figure 6** Illustration of the exchange of information between SBNAS and other STM services.

Below, these STM services support to SBNAS:

**Single reporting**, using SeaSWIM to seamlessly make the ship’s reporting information available along the route. The reporting information is transmitted in the beginning of the ship’s voyage, and will be confirmed in Phase 2. The normal reporting information is extended with information regarding the ship’s particulars and manoeuvring characteristics together with crew’s experience or the ship’s risk index. This information will be available for the service provider. Based on this information the shore-based service provider can also plan and schedule its service.

**Area management**, this service would include:

- Assess the local conditions based on several input information:
  - Weather analysis and forecasts
  - Present ice conditions received from IB and ships within the ice regimes
- Assess the navigation constrains:
  - Tidal level and currents
  - Safety warnings and MSI
  - Dynamic no-go areas
This information is used in:

- **Phase 1**: Establishing the route in the SBNAS area of operation, establishing a preliminary Navigation Plan.
- **Phase 2, 3**: Update the route and schedule within the SBNAS area of operation if required.
- **Phase 3**: Look ahead: Update the route and schedule within the SBNAS area of operation if required.

**Enhanced shore-based monitoring**, using the traffic image over the SBNAS together with the route database, an overview of the traffic situation may be achieved. One shore-based operator, supported by decision support tools, like anomaly detection and predictors, follows the traffic within the area with respect to:

- Deviations from planned route;
- Safety distances to navigation dangers; and
- Dynamic and static no-go areas.

If the operator identifies a ship leaving its route or heading into danger, the operator will immediately contacts the ship.

This overview of the traffic situation also gives an important input to the SBNAS in order to assess the traffic situation.

**Route optimisation**, the ship is using the normal Route Optimisation Service, but the specific route segment within the SBNAS area of operation is received from the SBNAS.

Initially, the ETAs to the different FPTs are preliminary and the precision will gradually increase as the voyage has started and the ship is approaching the different WPT. During the voyage, hence the strategic monitoring phase, information and forecasts gets more and more accurate, at the same time conditions not predicted will change, and a re-planning is constantly performed and the route is updated and disseminate to all actors and stakeholders.

Hence, the route optimisation relies on several other services for receiving local information. The overall routing optimisation service is provided by a private or official service provider.

### 3.4 Information needs

Based on the above operational description an information analysis has been performed for the actors:
- Ship’s Master/OOW; and
- Shore based operator.

This is summarised in table 2.

<table>
<thead>
<tr>
<th>Actor/Information</th>
<th>Source of information</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shore based operator</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Traffic image</td>
<td>FM: based on AIS information</td>
<td>Current targets within a specific geographical area:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Target ID</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Target COG and SOG</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Target position</td>
</tr>
<tr>
<td>Route data base</td>
<td>DVM: based on exchanged route</td>
<td>Current intended route planes and route schedule for all targets within a</td>
</tr>
<tr>
<td></td>
<td>information</td>
<td>specific geographical area and targets that will approach the area</td>
</tr>
<tr>
<td>Safety</td>
<td>NCA</td>
<td>NTM, MSI and other safety information within area of operation</td>
</tr>
<tr>
<td>Environmental</td>
<td>Meteorological and oceanographic office</td>
<td>Environmental parameters within the SIR:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Wind</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Current</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Sea State</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Ice and risk of icing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Tidal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Water level</td>
</tr>
<tr>
<td>SBNAS ship’s route and schedule</td>
<td>DVM: Route Optimisation Service</td>
<td>SBNAS made the original route segment. Route optimisation service optimise the whole route</td>
</tr>
<tr>
<td>Ship reporting information and</td>
<td>DVM: Single Reporting Service</td>
<td>• Ship reporting information.</td>
</tr>
<tr>
<td>additional ship information</td>
<td></td>
<td>• Ship’s particulars; and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Ship’s manoeuvring characteristics.</td>
</tr>
<tr>
<td>New route and schedule</td>
<td>DVM/FM: SBNAS</td>
<td>Suggested route plane</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Suggested route schedule</td>
</tr>
<tr>
<td>Voice and text communication</td>
<td>FM, DVM: SBNAS</td>
<td>Several possible communication channels</td>
</tr>
<tr>
<td>Master/OOW</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nautical chart</td>
<td>On-board system</td>
<td>Nautical chart</td>
</tr>
<tr>
<td></td>
<td>(M-ECDIS)</td>
<td>Intended route</td>
</tr>
<tr>
<td>----------------------</td>
<td>---------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>On-board traffic</td>
<td>On-board system (M-ECDIS, Radar, AIS)</td>
<td>Radar and AIS targets</td>
</tr>
<tr>
<td>image</td>
<td>DVM: Route exchange Service</td>
<td>Other ship’s routes via ship-to-ship route exchange</td>
</tr>
<tr>
<td>Planned route and</td>
<td>DVM: Route optimisation service</td>
<td>Ships intended route and SBNAS route segment</td>
</tr>
<tr>
<td>schedule</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Navigation Plan</td>
<td>DVM: SBNAS</td>
<td>For each leg:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Lighthouses, with characters and visual range</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Aids-to-Navigation (AtN)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Dangers and distance to dangers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Position fixing method</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• WO fixing method</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Turning radius</td>
</tr>
<tr>
<td>New route and</td>
<td>DVM: SBNAS</td>
<td>Suggested route plane</td>
</tr>
<tr>
<td>schedule</td>
<td></td>
<td>Suggested route schedule</td>
</tr>
<tr>
<td>Voice and text</td>
<td>FM, DVM: SBNAS</td>
<td></td>
</tr>
<tr>
<td>communication</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table 2** Information needs for the different actors.
4 Decision support tools

This section describes some of the potential decision supporting functions and other support tools that could be utilised by SBNAS.

4.1 Route advice using texting

Communication between the ship and the shore service can be made voice or by text messages that can be sent in both directions. Text messaging might also have benefits over voice. In a study made at Chalmers University of Technology in 2013 professional bridge officers and 4th year cadets found receiving text based navigational instructions in a land based deep sea pilotage scenario less stressful that receiving voice calls which they felt was necessary to attend to immediately. However, for time critical responses voice was preferred (Porathe, et al., 2014).

Text remains whereas voice needs to be written down

Test results indicate that route advice using text messages might be preferred compared to verbal voice instructions. The reason for this is that text instructions will be permanently available on the screen. They can be revisited to get clarification, they do not need to be taken care of instantly, like voice instructions which have to be written down at the same time as they are received though regardless of what the navigator is occupied with at the moment. This is also the reason why voice instructions will be to prefer for time critical information that must be attended to immediately.

Reading might be easier than talking and hearing

Another benefit with written instructions has to do with language proficiency. Written English is independent of pronunciation and accent of different individuals. In multi-ethnic shipping industry problems of pronouncing and hearing English spoken by different nationalities must not be underestimated. Cognitive science research shows for instance that several East-Asian languages do not distinguish between the letters “l” and “r”. Thus making it impossible to both hear and pronounce the difference between for instance the words “right” and “light” (Goldstein, 2008). And the same differences are true to a greater or lesser extent when individuals of different mother tongues talk with each other using a foreign language (English). As English is mostly tough through text books, such difficulties are to a large extent circumvented by using text communication. Text messages in remote pilotage scenarios are much like a modern electronic form of the traditional Sailing Directions. The difference is that the text messages will be distributed in portions at the right time, thereby decreasing the risks of misunderstandings. Sailing Directions was the first form of mediated navigational information we know of, the first examples being the Mediterranean Peripii starting from 400 B.C. Therefore text messages can to a large extent be prewritten by the shore service ready to send out to a ship that has reached a predefined part of the route. If
there are any questions from the bridge officer he can text questions back and thus keeping the VHF channel open for urgent traffic.

**An extra watch officer**
The availability of an extra pair of eyes in a shore facility will offer an extra safety barrier to ship and environment.

**Offloading voice**
In cases where urgent communication is needed, voice will be preferred, according to the study mentioned earlier. Voice will be faster and will cut in, in a more direct way. In many places the two available channels (pilotage channel and channel 16) will carry a lot of traffic making it sometimes difficult to get through. Text messaging will help relieve the voice channels from communication that may be done by other means. However, in this there is also a possible drawback. By shifting communication from public media like the VHF that can be overheard by all ships, to private media like a text chat that will only be visible to the parties involved, some of the common situation awareness will be lost.

### 4.2 Suggesting new route plan

In the case of a ship needing to change its intended route plan or route schedule or if the shore-based operator needs to change the route, it will not be sufficient to just use voice or text messages. Instead the function of route exchange between ship and shore can be used. If the ship already has started its journey the route may be changed by the function: suggested new route plane or suggested new route schedule. The reason for the change may be explained and motivated by the use of either voice or text messages. The receiving part reviews the proposed changes and a handshaking procedure follows. The new intended route is made available to all actors and stakeholders having access to the route.

### 4.3 Dynamic Position Predictor and anomaly detection

A standard predictor or the Dynamic Position Predictor (DPP) developed by SSPA in the project might be a possible support tool both for the OOW and the shore-based operator in order to early identify deviations from the pre-planned route. The DPP gives continuously position predictions within a range of 30s to 300s. The ship’s contour are displayed for the predicted positions and visualised at the ECDIS display.

![Figure 7](image.jpg)

**Figure 7** Ship’s position is predicted by the DPP and visualised on the ECDIS display.

The shore based operator could also be supported by anomaly detection function that automatically detects if a ship is leaving the pre-planned route. The algorithm constantly
compares the ships position received from the traffic image and comparing it with the intended route stored in the local route database.

5 Standard operating procedures

This sections starts by identifying high level tasks for the actors and based on that standard operational procedures (SOP) are given.

Disclaimer: The procedures given in this section are not complete. The purpose is to put the new functions and routines into an operational context. Part of the procedures will be used during simulation tests to evaluating the concept. The procedures should not be used operationally.

5.1 High level tasks

High level tasks are identified for the different actors in table 1:

- **Ship’s Master/OOW:**
  - Planning:
    - Establish detailed voyage plan
    - Decide on level of shore service interaction required
  - Strategic navigation:
    - Monitor weather and oceanographic conditions
    - Monitor overall voyage and port ETA
    - Perform changes to route plan and schedule if necessary
  - Tactical navigation:
    - Monitor track
    - Monitor margin of safety
    - Monitor UKC
    - Identify WO and perform turn
    - Monitor turn
    - Verify new course
    - Assess traffic situation, identify risk of collision
- Act on risk of collision
- Monitor status of the navigational equipment

• **Shore Based Operator (acts within certain area of operation):**
  - **Planning:**
    - Plan and manage assistance services
    - Perform detailed route planning
    - Establish Navigation Plan
  - **Look ahead:**
    - Monitor safety information, weather and ice conditions
    - Monitor traffic using “Enhanced Monitoring Service”
  - **Tactical navigation:**
    - Monitor track
    - Monitor margin of safety
    - Monitor UKC
    - Identify WO
    - Monitor turn
    - Confirm new course
    - Assess traffic situation, identify risk of collision

• **VTS operator (act within a VTS area)**
  - Perform VTS service
  - Monitor traffic
  - Monitor safety information, weather and ice conditions

5.2 **Shore based service operator procedures**
These procedures are derived using the same principles used for VTS in [IALA, 2011]. The shore-based service operator is here denoted only operator.

**Watch handover**
The watch handover procedures should include information as:
- Current traffic situation
- Expected/developing traffic situation
- Incidents or on-going operations (pollution, SAR)
- Weather and oceanographic conditions
- Recent and current MSI
- SBNAS ship handover

**Phase 2: Outside the area**
Before a ship is entering the SBNAS area the operator has to confirm and check all necessary information:
- Check ship’s selection of service
- Check intended route plan and schedule
- Check a current navigation plan

**Phase 3: Entering the area under assistance**
Just before the ship is entering area the operator:
- Establish voice and text communication
- Confirming ship’s selection of service
- Confirming intended route plan and schedule
- Check route exchange function
- Communicate navigation assistance procedure and protocol
- Communicate the navigation plan for the passage

**Phase 4: Monitoring**
Phase 4 is monitoring and coordination of the ship traffic. A traffic image is established including both participating and non-participating vessels. The image should clearly indicate each target which type of vessel it belongs to. If the SBNAS area is large, it is divided into sectors with one operator assign to each sector.

All participating ships are treated as to follow Enhanced shore-based monitoring services:

- **Ship entering SBNAS area from open sea**
  Ship entering the area triggers an alert for the operator. Route and observed target are automatically correlated and confirmed. Ship entering the area should be activated by selecting the target. The ship is now assigned to a dedicated operator and any deviation from the route is automatically detected by the anomaly detection function in the system.

- **Ship entering SBNAS Area from VTS area**
  The VTS operator handover the ship to the SBNAS and triggers an alert for the operator. Route and observed target are automatically correlated and confirmed. Ship entering the area should be activated by selecting the target. The ship is
now assigned to a dedicated operator and any deviation from the route is automatically detected by the anomaly detection function in the system.

- **Ship within SBNAS area**
  The ship is assigned by a dedicated operator and any deviation from the route, XTD or ETA, is automatically detected by the anomaly detection function in the system and the operator makes contact to the ship. Any unsolved closed quarter situation is detected by the anomaly detection function and the operator makes contact with the involved ships.

- **Ship at anchor**
  A ship at anchor is only monitored that it is not drifting out of its safety radius. An alert is automatically detected by the anomaly detection function in the system and the operator contacts the ship.

- **Ship leaving SBNAS area for open sea**
  A note is made and the ship is deleted from the active ships list.

- **Ship leaving SBNAS area for VTS area**
  If a ship leaves the SIR area and enters a VTS area the ship is handed over to the VTS operator. The VTS operator has the ship’s route information and which is assigned to the target. The ship doesn’t need to call the VTS operator.

- **New MSI**
  One assigned operator is responsible for new MSI for the SBNAS area. The MSI is transmitted according to normal channels but is also visualised on the on board equipment.

- **Monitoring of non-participating ships**
  Ships that are not part of the system are monitored by means of AIS. Deviations from route cannot be detected. However, if a dangerous situation occurs the operator should make contact with the ship.

SBNAS:

- **Route deviation**
  The operator monitors the ship’s route and detects any deviations. If a deviation is detected, the ship should be notified and corrective actions discussed.

- **WO**
  When the ship is approaching the next WO point or line, the ship should be notified. The turn should be monitored and the new course should be verified together with the ship.

- **Risk of collision**
  If a risk of collision situation is detected by the operator, the ship should be notified. The ship decides and performs appropriate manoeuvre. The operator is following up the effects of the manoeuvre.

- **Safety information**
  Safety information and MSI should be passed over to the ship.
• **Look ahead**
  Look ahead along the ship’s voyage in order to detect possible navigation hazards, traffic situations and if necessary propose route and route schedule changes.

**Emergency:**
If the ship under assistance or any other ship within the area of operation is in an emergency situation, the operator needs to act. Procedures covering various possible emergency situations need to be established and practiced. i.e.:

- **Ship not under command**
  When a vessel Not Under Command (NUC), emergency towing service should be notified and the ship’s contingency plan should activated.

- **Search And Rescue (SAR)**
  When observing a SAR alert MRCC should be notified according to GMDSS. MRCC is now in command and can use the Shore-based traffic image and services.

- **Medical emergency**
  MRCC should be informed. Shore-based operator can help to establish contact to Radio Medical Services

### 5.3 On board navigation procedures

It is important to note that the Bridge SOP should meet all requirements stated in international conventions and national laws. The assumptions made here is that the SBAS is a local voluntary service that can be assigned before the departure from the port prior to the SBNAS area. Procedure steps beginning with STM or SBNAS mean that this is a changed or new processes that is introduced by the STM concept. The procedures are not complete. The purpose is to put the new functions and routines in a context.

#### 5.3.1 Planning

As already stated [STCW, 1995]:

> The voyage needs to be planned in advance. The plan should also include pilotage and in port movements.

The following should be noted with respect to voyage planning (Anwar, 2008):

- Planning should be conducted by Navigating Officer under the Master supervision
- The Master should approve the voyage before leaving the port
• **STM:** The Master should approve the voyage segment received from Service Provider before activating it in the ship's navigation system.

• A change of route will require a new voyage plan which should be created and approved before the ship proceeds on the new route

• If the OOW cannot follow the plan, for whatever reason, the Masters should be called. Changes should be documented and the bridge team should be informed.

• **STM:** The route changes within the SBNAS area should be sent to the Service Provider

**STM:** route cross-checking and optimisation services: The route and schedule including departure time and ETA are transmitted to a service provider for validation and advice. The service provider checks the voyage plan with respect to:

- Navigation constraints
- Static and dynamic restricted areas
- Safety margins
- Traffic constraints
- Environmental protection constraints
- Local weather and sea state
- Pilot/tug constraints
- Port constraints

### 5.3.2 Monitoring

- Within a the SBNAS area the operator is monitoring the progress according to the intended route and route schedule and provide navigation assistance

- The operator can transmit route and route schedule change messages due to current MSI
The role of the Master is:

The Master has the overriding authority and responsibility to make decisions with respect to:

- Safety of life
- Safety of property at sea
- Preventing pollution of the marine environment

Commercial considerations are never allowed to take precedence over the primary concerns of:

- Safety of life
- Safety of property at sea
- Preventing pollution of the marine environment

STM: the Master has the overall responsibility and do not have to follow the operator’s advice.

The Master should set up rules when he should be notified:

- New route suggestion from the operator
- Any major deviations from the intended route
- Loss of communication with the operator

The role of the OOW is:

The OOW is responsible for the safe navigation of the ship during his time period of duty. He should specifically avoid grounding and collision. The OOW should read and understand:

- Stand operating procedures
- Standing orders
- Night orders

Navigator/Lookout set-up:
The Navigator’s tasks are:

- Route monitoring
- Anti-grounding
- Anti-collision
- Lookout
- GMDSS lookout

**SBNAS:**
- Use Lookout as assistant when receiving a new route suggestion
- Call the Master when receiving a new route suggestion. New route to be checked and agreed by the Master
- The OOW should understand the route agreed with the operator and the navigation plan

During the watch the OOW has limited possibilities to perform other duties as **check change route messages**. If any doubt, extra duties have to be postponed or extra lookout or officer or Master has to be called.

Handing over the watch is a critical period and should be postponed if:
- A manoeuvre is imminent
- **STM**: when a new route change message is received

The OOW should notify the Master immediately if:
- In any emergency or breakdown of equipment
- Restricted visibility
- Traffic condition which raise concerns
- Difficulty to follow voyage plan and course
- Nearby Ship or person in distress
- Heavy weather, ice, etc.
- **STM**: reception of a route or schedule change

The OOW should always cross check all information if possible.
The OOW should use two or more different methods for position fixing and course monitoring **STM**: the OOW should check that the intended route is consistent with the activated ECDIS route.
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