



TEN-T PROJECT NO: 2010-EU-21109-S

**CONCEPT FOR ACTIVITY 1:  
DYNAMIC & PROACTIVE ROUTES OR  
“GREEN-ROUTES”**



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## **ANNEXES - LIST OF ABBREVIATION**

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# 1 INTRODUCTION

## 1.1 Scope and purpose

This document reports MonaLisa project Milestone 2: Route planning analysis and assessments completed; system designed for Activity 1.

## 1.2 Objectives and expected benefits

The Activity aims to develop and test a new model in route planning based on existing Electronic Nautical Charts (ENC) and Automatic Identification System (AIS). Each vessel's preplanned route will be visible for other vessels and monitoring centres ashore. The estimated best route and speed plan will be agreed on between captains and pilot centres which have knowledge about the local sailing conditions such as currents, wind and waves, water depth and ice that affect sailing time and bunker consumption but also traffic congestion, availability of berth in the next port of call and cargo handling schedules. A major benefit from a better routeplanning is the reduction of fuel consumption and its related emissions. With a full implementation of *Green-Routes* we calculate with a reduction of fuel between 5-10 % for a normal voyage in the Baltic Sea. A direct result of this is not only added value for the environment but also economic reasons. Additional to these traditional routeing values and parameters, MonaLisa will also look into the tool maritime spatial planning (MSP), where our public society must identify a suitability map for certain uses, based on the best scientific or stakeholder's knowledge. Including areas important for the fish growth and reproduction, areas with good conditions for wind or wave-farms, areas that secure healthy biodiversity, areas where pipes and cables can be placed securely and protected etc. MonaLisa will strive to deal with these areas or other kinds of restricted sites in order to fulfil demands and necessity's with the objectives to preserve our nature and wildlife.

Radio communication traffic between vessels will be heavily reduced when pre-planned routes clearly describe all navigators intended routes on bridge displays. Monitoring centres and others will immediately see if a vessel is deviating from a pre-planned route and will be able to take action. All vessels routes will be available for other ships for anti-collision purpose.

One important input to Activity 1 is newly produced ENC charts with quality assured depth data sets, to have guarantees that the dynamic *Green-Routes* can be planned over the sea areas with all the dynamic data inputs effectuated, in order to allow the vessels to avoid squat effects, reduce speed in shallow water areas and to use deep water areas for full speed.

# 2 BACKGROUND AND JUSTIFICATION

Today most operating ships have a very well defined route to follow between berthing's. The route is often programmed into the ships navigational units and its prepared by the



Captain/ships officers, but in all details only known by the ship's crew and not shared with other parties. However, the general voyage plan for a ship is often known by some of the stakeholders within the maritime sphere, but other ships or stakeholders are not updated in details, like flight routes in the Air Traffic Management (ATM).

The scope of Dynamic and proactive Route planning, also called *Green-Routes* is to produce a traffic guiding and monitoring concept to be tested in the Baltic Sea Region. Parallel studies may also take place in China within an e-Navigation action plan of MoU between Sweden and China. Dynamic and proactive Route planning will be one important subset of IMO's e-Navigation strategy.

Similar methodology, ATM, as mentioned above, can be found today in air traffic controlling systems, where all flights are preplanned, monitored and acknowledged by all involved parties. Also the flow of trains uses similar systems, called ATC (Automatic Train Control) to give a safe and secure system controlling the movements of trains.

The *Green-Routes* concept puts the Captain and the ship in centre of the process in order to achieve maximum safety and to provide the ship with assistance during the sea passage from berth to berth. The Captain is in charge and both UNCLOS (United Nations Convention on the Law of the Sea) and COLREG has to be followed in the ships SOP (Standard Operational Procedures).

The all overarching idea of *Green-Routes* is to introduce a new concept of managing traffic flow at open sea, VTS (Vessel Traffic Services) areas not included. This will be achieved by new processes and methodologies of exchanging data information between ship and shore and ship-to-ship.

Today there's no organized traffic control from shore over open sea areas. Detection and identification of movements are executed randomly by different authorities (Coast Guards) in different countries. Some areas around the world have introduced SRS (ship reporting systems) usually operated by coastal VTS, where-to ships entering the SRS areas shall report ships data and destination.

At TSS areas (Traffic Separation Scheme) traffic flow are separated by geospatial limitations marked at charts and enhanced sometimes physically with buoys. Those areas can, but not always are, monitored by authorities.

### **3 BASIC CONCEPT**

The concept of *Green-Routes* is to move closer to the air traffic management concept of sharing voyage plans with all participants in order to improve both the predictability in the system and the situation awareness for everybody involved. *Green-Routes* will also provide Captains with the best available voyage plan for their ships in terms of lowest fuel



consumption, shortest way or other criteria chosen by the Captains. All voyage plans will be shared and available for other ships in order to improve the understanding between ships approaching conflicting points. In longer terms when all or most ships have adopted the *Green-Routes* system the monitoring and detecting procedure of today will be phased out and exchanged by flow management as we already can see in the air traffic management system of today.

**The functions of Green-Routes have four main features:**

***1/ Route construction:***

A unique and optimized route, based on the needs of the Captain, the actual data of the vessel, cargo owner, port capacity, weather, geospatial limitations and the traffic patterns, will be constructed by a VTMISS (Vessel Traffic Management and Information Service centre) in cooperation with the Captain. The route to be delivered in a universal data format, accepted by the ships Navigational Display Units.

***2/ Monitoring and assistance:***

All participating vessels ability to stay on track of the preplanned routes will be automatically and/or manually monitored and assisted from the VTMISS. Any deviations from agreed routes will alarm VTMISS and necessary actions can be taken.

***3/ Anti-collision Aid:***

The routes of participating vessels will be available for other ships to be downloaded and presented on their Navigation Display Units. This function will be a helpful additional aid for meeting ships in order to foresee and preplan the manoeuvring of the ships.

***4/ Surveillance:***

The reduction of "unknown vessels" in terms of routeplanning will reduce the necessity of coastal surveillance in real time of all ships. The focus of the surveillance authorities can be restricted to the non-participating vessels which will increase the quality and possibility to detect hazardous or malicious anomalies.

## **4 SYSTEM CONCEPT**

The test area for the concept will be the Baltic Sea Region and some of the ports within this area. Some defined vessels and a temporary test bed STC, will be used for testing the concept. Prior to real-time tests on board ships, the concept will be evaluated in simulators in order to validate the services with officers and VTS operators in realistic environment.



A holistic and a systematic view of routes and exchanging route information have been established. The overall system works in four modes of operation, in analogy with AIS:

- Ship only, as today
- Shore only, as today
- Ship-to-ship, new mode (introduced by the EfficienSea project)
- Ship-to-shore, new mode (introduced by the EfficienSea/MonaLisa project)

**Ship only mode:**

- Each voyage should be planned from berth to berth
- The officer on watch monitors that the ship follow the planned route
- The Captain updates the planned route regarding weather routing/ETA optimization

**Shore only mode:**

- STC operators monitor the path of ships within their sector

**Ship-to-ship mode:**

Exchange of route information between ships within the horizon in order to:

- Enhance the onboard traffic image (together with Radar and AIS data)
- On scene coordination of SAR and oil response operations (search patterns)

**Ship-to-shore mode:**

Exchange of route information in order to receive:

- Enhanced traffic image ashore for traffic monitoring
- Enhanced traffic image ashore for traffic control
- Weather routing/ETA optimization



## 5 OPERATIONAL VIEW

An Operational View of the concept is depicted in the figure below, identifying system actors and stakeholders.

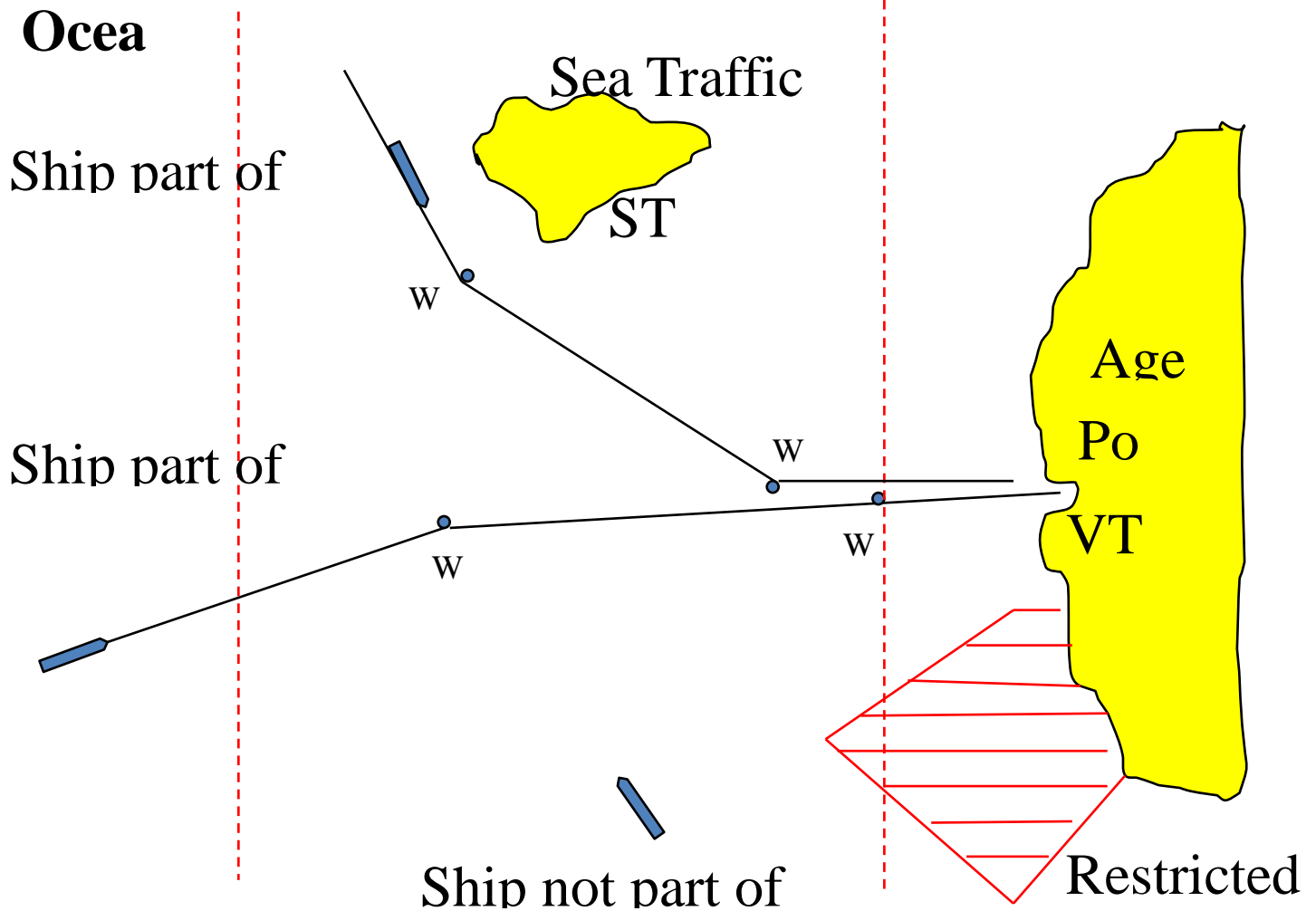


Figure 1 An Operational View of the concept illustrating a scenario with one ship participating in the system entering the system region, one ship participating in the system moving inside the system region, and a vessel not participating in the system.



In the Operational View the following operational elements can be identified:

- **Actors**, which are part of the system
- **Stakeholders**, working outside the system, which are benefiting from the system

In the Operational View above the following actors are identified:

- **STC center**. This is the operational center of the system
- **Ships participating in the system**. This is merchant ships that voluntarily exchange its planned route to the STC center. These ships are continuously monitored by VTS centers along the routes.
- **Ships not participating in the system**. This is all other ships that do not participate in the system. It is very important to take this type of vessel into account in the system design, when the system is a voluntary system. The following vessels can be of this category:
  - Other merchant ships
  - Fishing vessel
  - Leisure ships
  - Governmental ships

A first set of stakeholders have been identified. These are summarized in the table below together with identified benefits of the concept.

<b>Stakeholder</b>	<b>Benefits of the concept</b>
Ship owner Agent	Optimized route with respect to Traffic, weather, fuel consumption, ETA
Port	Optimized ETA with respect to Port working Accurate ETA
Pilots	Optimized ETA Accurate ETA
Cargo owner	Optimized route with respect to Weather Optimized and accurate ETA
VTS	Enhanced traffic monitoring of ships participating in the system Enhanced work load-focus on vessels not participating in the system
SRS	Enhanced traffic monitoring of ships participating in the system Enhanced work load-focus on vessels not participating in the system

Table 1 List of identified stakeholder with expected benefits.





## 5 ROUTE EXCHANGES

The processes of exchanging route information, in a scenario as shown in Figure 1 are described below:

### **1/ Initial route:**

The core in the whole process is the voyage plan. A voyage plan is mostly constructed with a route as a general frame, using values of geospatial coordinates (waypoints) from point of departure to point of arrival. Similar as flight plans, the original route will be handed over from the Captain to STC with all necessary criteria's that the ships demands.

### **2/ Construction of voyage plan:**

STC are constantly provided with real-time data from Meteorological agencies, next port of call, pilot stations, soundings, area restrictions, traffic patterns etc.

Within the scope of MonaLisa only parts of these incoming data can be elaborated in the route construction algorithms, not all of them. The project will identify as many as possible and formulate pathways for solutions but the completion of a fully operating route construction program that can handle and calculate any kind of interfering data will require validation beyond the scope of MonaLisa and be left to private entrepreneurs to solve and offer to the market. These data will be elaborated together with the needs and a criterion's given by the Captain and finally a complete voyage plan will be produced and transmitted over to the ship.

### **3/ Acceptance:**

Acceptance of the Voyage plan must be signed by Captain, (digital handshaking).

### **4/ Follow up:**

The ship starts to follow agreed Voyage plan and thus, the ship can be monitored from STC in their flow management tasks. Any deviation from agreed plan will automatically and simultaneously alarm STC centre and on board ship.

### **5/ Situational awareness:**

Any conflicting points with other *Green-Routes* ship will be detected simultaneously by ships and STC and can be dealt with according to COLREG. Note that Captains always are in charge of their vessels and it's manoeuvring. Note also that any other ships must be considered and action to be taken as usual according to the COLREG.

### **6/ Surveillance:**

The more ships operating under the *Green-Routes* umbrella, the less unknown ships will be handled by maritime surveillance authorities, and that will give them higher quality in their duties.



## ANNEXES - LIST OF ABBREVIATION

AIS	Automatic Identification System
ATM#1	Air Traffic Management
ATC#2	Automatic Train Control
COLREG	International Regulation for Preventing Collisions at Sea
ENC	Electronic Nautical Chart
ETA	Estimated Time of Arrival
STM/STC	Sea Traffic Management/Control
SAR	Search and Rescue
SOP	Standard Operational Procedures
SRS	Ship Reporting System
TSS	Traffic Separation Scheme
UNCLOS	United Nations Convention On The Law Of The Sea
VTS	Vessel Traffic Service
WP	Waypoint

