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Sea Traffic Management – A Holistic View

Co-financed by the European Union
Trans-European Transport Network (TEN-T)
## Document Status

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1 Introduction

1.1 What is Sea Traffic Management (STM)?

STM takes a holistic approach to services, making the *berth-to-berth ship voyage* efficient, safe, and environmentally sustainable. Hence, STM puts the voyage in focus and uses that as a core element for safety and process optimization, and actor and stakeholder interaction.

In order to define STM, user needs are put in focus and a holistic view of the voyage is achieved by using legal/institutional, operational, information, and technical perspectives. Further, STM builds upon an enhanced interaction ship-to-ship, ship-to-shore, shore-to-ship, shore-to-shore enabled by information sharing empowered by enhanced service interaction.

In summary:

STM is a concept for sharing secure, relevant and timely maritime information between authorized service providers and users, enabled by a common framework and standards for information and access management, and interoperable services

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 collaborative ports. The STM concept includes concepts for strategic and dynamic voyage management, flow management, port collaborative decision-making, enabled by distributed and service-based information management.

1.2 Why STM?

Enhanced collaboration and information sharing among actors in the maritime transport sector is necessary in order to optimize current processes and services, as well as to provide new innovative opportunities. STM builds upon continuous real-time based information sharing about intentions and actual achievements among maritime actors.

It is thus expected that the enhancement of the areas covered by the STM concept can lead to improvements in:

• **Situational awareness** for the purpose of facilitating:
  • A reduced number of accidents and incidents (proactively de-conflicting routes)
  • Optimized resource utilization by learning the intentions of other actors
  • Secured passages by knowing what the intentions of other actors are
• **Predictability** of arrivals and departures by early information sharing; this will enable better planning for involved actors and lead to reduced idle time for resources;

• **Just-in-time operations** by enabling stakeholders and service providers to be efficiently organized for handling ship movements, port resources, and hinterland connections; and

• **The innovation capability** in the ecosystem, which can give rise to the increased availability of unforeseen, non-vendor dependent, and interoperable services at low cost

A common information sharing and service infrastructure, SeaSWIM, is motivated by the gains that can be reached in STM related activities, i.e. in Voyage Management, Flow Management, and in Port Collaborative Management. It is expected that the introduction of SeaSWIM would enable the innovation and dissemination of services that have not yet been thought of both within STM, as well as within other maritime domains relying on substantive interaction between maritime stakeholders. By joining forces with other maritime initiatives (cf. Figure 1), the goal is that these different initiatives use the same infrastructure.
2 STM Description

STM puts an emphasis on interoperable and harmonized services that can allow a ship to operate in a safe and efficient manner from port to port with a minimal impact on the environment. The minimizing of the use of energy to steam between two ports and the maximizing of the use of facilities in ports are in focus.

In the current definition of STM, the voyage is the central element of analysis and development. STM covers all actors (both land- and sea-based) and their operations from voyage planning, dynamic re-planning and departure to port arrival and evaluation; it relies on the foundational process logic depicted in Figure 2.
Figure 2: Foundational process logic for STM

Essentially, the provided infrastructure enabling STM will come as a layered model (cf. Figure 3) that different service providers can use to provide and consume services. This means, for example, that access to particular information services would enable the distribution of new information services and/or allow integration in different applications. This also means an essential move from vendor-specific solutions to the inclusion of diverse service providers enjoying new business opportunities.

Figure 3: A layered service model

The main focus of STM is to improve navigational safety, sea traffic efficiency and to reduce the overall environmental impact caused by the maritime sector. Additionally, there are seven sub-objectives that, together with the three main ones, outline the scope of STM (presented in Figure 4).
2.1 Improved Navigational Safety

Based on an increased ship-to-ship, and ship-to-shore interaction, improved navigational safety is achieved by increased situational awareness and receiving the right information at the right time. Shore-based organizations can contribute considerably by adding valuable information and advice based on:

- An enhanced traffic image which can be used to detect potential collisions, groundings, traffic congestions (and, thus, be used to alert ships); and
- Updated regional information, which is an effective way of informing ships about potential hazards.

2.2 Improved Sea Traffic Efficiency

The efficiency goal is achieved by enhanced information sharing among involved actors (ship-to-ship, ship-to-shore, and shore-to-shore) in which intentions and actual performances are shared in real-time. The information owner determines access rights. Information related to the voyage is shared with nominated recipients via subscription services for the purpose of optimizing the voyage (to steam between two ports), optimizing the flow of ships in condensed zones, and optimizing the port call. Such optimization builds upon a high ability to predict state changes and thus the upcoming need of resources. This means that a basis is created for enabling a maximized utilization of existing resources.
2.3 Reduced Environmental Impact

The environmental impact is reduced by enabling decision support to minimize the use of energy to steam between two ports, to promote just-in-time approaches to ports, and to minimize shipping in sensitive areas. Just-in-time approaches could be matched with a synchronized readiness in the port, which would both enable green approaches as well as green steaming based on avoiding late departures going to the next port. Fast turn-around processes also provide possibilities for increased utilization of the ship as a means of transportation.

To reach these improvements, a service-based and regulated information-sharing framework is required. The basic logic behind STM builds upon the following principles:

1. A voyage is defined and all its attributes are connected to a unique voyage identifier;
2. Information related to the voyage, the basis for sharing, is connected to the voyage identifier;
3. Operative intentions of sea- and land-based actors are provided to others well in advance and kept up to date;
4. Trust is put in focus in the shift from personal contacts to ICT services;
5. A collaborative attitude is empowered in information sharing and decision making;
6. One single point of reporting;
7. Situational awareness is derived from multiple informational sources;
8. Secure and authorized service realization; and
9. Discovery and distribution of services are realized through an infrastructure governed by a federation.

Further, the following prerequisites are used in the STM definition:

- The Master is in command;
- The UNCLOSE and/or COLREG are not violated;
- Existing systems and initiatives are considered; and
- Information ownership is managed by access control and authentication.

STM is a framework, a harmonization of data formats and standards for information management and operational services. Some of the standards enabling STM are:

- Route exchange format
- Port call message format
- Other text message format
• Time stamp definitions
• Service specification language
• Processes for approval, distribution, and discovery of services
• Processes for federated governance of service portfolio
• Access management

The STM concept, as outlined above, is defined by its operational services. STM involves already existing processes and services and, in some cases, newly defined services by:
• Enhancing existing services
• Proposing and validating new innovative services

2.4 The STM Sub-concepts

On a general level, the sea voyage is divided into planning, execution and evaluation services (cf. Figure 5). However, since the execution phase contains the majority of the defined service portfolio, this is further divided into services for dynamic navigation, traffic coordination, and port call synchronization and optimization. This division also relates more directly to the STM sub-concepts detailed below.

![Figure 5: Overview of STM planning, execution and evaluation phases](image)

**Strategic Voyage Management (SVM):**
• To optimise the voyage plan of a sea voyage before sailing; and
• To nominate collaborators and govern access rights to services and information.

**Dynamic Voyage Management (DVM):**
• To continuously adjust the voyage plan in order to run the ship in the most cost-efficient, safe, and sustainable way; and
• To enable information services to give a complete real-time picture for optimization.

**Flow Management (FM):**
• To optimize throughput and increase the safety of the sea traffic flow in congested areas; and
• To recommend arrival times to and speed in the areas by using slot allocation.

**Port Collaborative Decision Making (PortCDM):**

• To provide a basis for collaboration between key actors within the port and towards its surroundings based on shared situational awareness enabling increased predictability;

• To enable just-in-time arrivals of ships, just-in-time operations and, further on, just-in-time integration with hinterland transportation leading to optimized turn-around processes; and

• To enable improved resource utilization for all involved port actors and optimized operations.

**Distributed Information Management – SeaSWIM:**

• To provide trustworthy information sharing and a service framework including common standards, infrastructures, processes and governance.

• To enable federations to take responsibility for parts of the ecosystem such as:
  
  o IALA – navigational data, infrastructure
  
  o IHMA/ESPO/IPCSA/Port CDM Council – port (reporting) data
  
  o IMO – definitions
  
  o Transport associations/BIMCO – goods information

• To enable automation of information exchange and reporting related to e.g.:
  
  o Single Window interaction
  
  o Traffic area report
  
  o Noon reports
  
  o Port reports
3 Concluding Remarks – Towards Increased Information Transparency

The introduction of STM sets focus upon enabling safe, sustainable, and efficient sea transports. STM is a response to the need to increase efficiency and safety in operations within and between ports. In the validation of the STM concept it is shown that substantial savings of bunker costs could be earned, that safety can be enhanced, and that a high utilization of the resources of the facilities in ports can be reached while maintaining a high degree of safety. 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. 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 purposes. As the maritime sector is constituted by autonomous organizations acting in competition, peer-to-peer information exchange needs to be built upon. A service-based approach regarding the distribution and discovery of information that avoids the centralized storage of data as well as a unified communication channel is therefore preferred.

In the maritime industry of today there are many competing autonomous actors putting a great deal of emphasis on developing their own systems/solutions, most of which are vendor-specific. This causes a non-harmonized situation with unnecessary lacks of interoperability. The entry barriers for new service providers are too high, jeopardizing the innovative capability of the industry. There is a need for more standards for information sharing and service interaction connecting key actors of the maritime ecosystem to enable safe, efficient, and sustainable sea transports. STM thus proposes a common service distribution and information sharing framework enabling trusted, non-proprietary, and federated collaboration. Such a framework would enable third-party developers to provide new innovative services to the industry. The introduction of the framework is motivated by the gains to be reached within the key concepts of STM; strategic and dynamic voyage management, flow management, and port collaborative decision making.

Even though the global economy is mostly propelled by maritime transport, the transport sector is really concerned with transporting goods and people from door-to-door. Today, the accuracy of when certain cargo will be at a certain location is too low. Through the introduction of STM, it would be possible to share essential information among key actors in the inter-modal transport chain. This means that STM brings Sea Transports into the light with accurate information on departures and arrivals. Services providing information about arrival and departures of ships to/from ports have a key role in the success of inter-modal integration and synchronization (cf. Figure 6). At the end of the day, different traffic means, including hinterland transports and sea transports, need to exchange information in order to make each transport means as efficient as possible. The total performance of a chain is never stronger than its weakest link. With STM, a basis for efficient inter-modal transportation will be established.
Figure 6: The sea voyage as an integrated part in a larger inter-modal transportation chain
39 partners from 10 countries
taking maritime transport into the digital age

By designing and demonstrating innovative use of ICT solutions
MONALISA 2.0 will provide the route to improved

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