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| IALA Guideline |

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Guideline on VTS Digital Communications

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# INTRODUCTION

Effective communication is an essential component for operations in the maritime domain and is achieved when the intended meaning of the sender and the perceived meaning of the receiver is the same.

If a vessel intends to use IMO Maritime Service MS-1 Vessel Traffic Service (IMO circular MSC.1/CIRC.1610/rev.1), it must be capable of receiving these and must subscribe to the services. The vessel is responsible for managing its subscriptions to and unsubscriptions from the services. Vessel Traffic Service (VTS) should ensure that VTS personnel are aware of which vessels have received information digitally, eliminating the need for duplication via VHF. If a vessel has not received the information digitally, the VTS personnel are responsible for providing it via VHF voice communication in the conventional manner.

Modern technologies have improved communication through digital means. Compared to traditional voice communication, digital communication offers several advantages, including speed, efficiency, and reduced risk of misunderstandings. It can be used both with human involvement and in automated processes without human intervention.

Providing digital communication in a globally harmonised way requires a common understanding of the operational functions and standardised technical services.

Kuva, joka sisältää kohteen teksti, kuvakaappaus, diagrammi, viiva

Tekoälyllä luotu sisältö voi olla virheellistä.

Figure 1 Illustration of different levels of services and functions in relation to the document context

This guideline describes the operational procedures and functions which are specific to Vessel Traffic Service (VTS) as defined in Maritime Service 1 (MS 1) “Description of maritime services in the context of e-navigation (IMO circular MSC.1/CIRC.1610/rev.1). This guideline does not describe the services which might be used by the VTS but belong under the responsibility of other international bodies.

In the following documents essential principles for the safe and efficient digital communication are mentioned and are used as a base for this Guideline:

* IMO Resolution *A.1158(32) Guidelines for vessel traffic services* states:

*“Effective harmonized data exchange and information-sharing is fundamental to the overall operational efficiency and safety. VTS providers are encouraged to make use of automated reporting where possible.”*

* IMO circular *MSC.1/Circ 1595 E-navigation strategy implementation plan – update 1* states:

*“As shipping moves into the digital world, e-navigation is expected to provide digital information and infrastructure for the benefit of maritime safety, security and protection of the marine environment, reducing the administrative burden and increasing the efficiency of maritime trade and transport.”*

And that of the prioritised e-navigation solutions is:

*“…improved communication of VTS Service Portfolio (not limited to VTS stations).”*

* IMO circular MSC.1/CIRC.1610/rev.1 *Descriptions of maritime services in the context of e-navigation* defines the purpose of MS 1 Vessel traffic Services (VTS) states:

*“The purpose of this digital Maritime Service is to support the provision of VTS to participating ships by providing information in a digital format. Information could be presented in appropriate systems on board and ashore in order to create the means to reduce the administrative burden and information overload, reduce miscommunication due to external interference, simplify work procedures, promote sustainable shipping and increase navigational safety*.”

# DOCUMENT PURPOSE

The guideline defines functions and services for digital communication from a VTS operational perspective and aims to harmonise VTS digital communications through standard procedures and technical services.  
The technical services for exchanging digital information between vessels and VTS are still under development. The operational requirements set out in this document should therefore guide their further development.  
Reference is made to the IALA website (“Topical Matters”), which provides VTS digital functions and use cases to serve as a basis for ongoing work. The document “Use Cases for VTS Digital Communications” is a living resource, updated as digitalisation advances and new technologies emerge, supporting the continuous improvement of VTS operational procedures.

# DOCUMENT STRUCTURE

This document consists of two parts:

* Part A sets out the general principles for digital communications including current technologies used to exchange VTS information
* Part B provides guidance VTS Digital Communication Functions

In addition to this Guideline a document on the IALA website under the “Topical Matters” provides operational elaborated use cases of VTS Digital Communications.

# PART a GENERAL PRINCIPLES OF VTS DIGITAL COMMUNICATIONS

## MANAGING A MIX OF VOICE COMMUNICATION, DIGITAL COMMUNICATIONS, AND AUTOMATED DATA EXCHANGE

The digitalisation of information will diversify the communication means between shore and vessels and will affect VTS procedures regarding exchange of information. VTS interaction with vessels has traditionally almost exclusively been via VHF voice communications. It is expected that VHF voice communication will be partially replaced by digital communication in the future. The mix of voice communication, digital communication, and automated data exchange can differ from VTS to VTS.

VTS has to manage the mix of voice communication, digital communication, and automated data exchange. The use of digital communication could reduce workload by automating repetitive tasks, which could lead to reduction of the VHF traffic, communication barriers and the risk of misunderstandings. Digital communications also have the opportunity to disseminate information as well as consolidate and process the information for better decision support.

Messages can be conveyed to an individual vessel or a group of vessels. This not only includes person-to-person but also person-to-machine, machine-to-machine and machine-to-person communication. The change of communication and interaction to digital can also utilise automated processes in many situations.

The introduction of digital communication marks a period where digital communication and voice communication exists next to each other. The gradual advent of technical services may potential increase VTS workload, as the same tasks must be executed using both the new and old methods side by side. Over time digital communication holds the potential to reduce workload by automating repetitive tasks and voice communication.

Voice communications can be also used in addition to digital communications for example for urgent and time critical messages and can act as a backup for digital communication service technical failure.

### INFORMATION ORIGINATING FROM SOURCES OUTSIDE OF VTS

When transitioning to digital communications some of the information provided to vessels today by VTS may be provided directly to vessels from other sources. This can include for example hydrographic and environmental information, information on AtoN’s and Maritime Safety Information (MSI).

### CYBER SECURITY

From the VTS point of view the digital data exchange is secure (GL1182) unless the system indicates the data quality is insufficient due to reduced cyber security level. In these cases, the VTS personnel will revert to voice communication and the conventional way of working. For cases in which cyber security is impaired and not system detectable, VTS personnel should receive training how such cases might be observed and detected.

### TECHNICAL FAILURES

In case the digital communication service suffers a technical failure, it is VTS´s responsibility to have alternative procedure in place. One option is to revert to the conventional way of working with voice communication. It is possible that the VTS operators will not be able to revert to the conventional way of working serving the amount of traffic at hand. The other possible option is to have technical requirements to have a redundant digital communication system or a back-up system.

### HUMAN MACHINE INTERFACE (HMI) ASPECTS

Digital communication has the potential to streamline the VTS operations for a VTS center. It depends however highly on the specific implementation in the VTS system to which level an individual VTS operator is supported in his task. From a system architecture perspective and system acquisition perspective it might seem a logical solution to have digital communication functionality added as a separate function on the VTS operator working position. The real benefit of digital communication however will only be achieved with an HMI solution which supports the task of the operator optimally with an integrated HMI solution. Especially for VTS centers where the workload of the VTS operators forms a bottleneck in the operation, the HMI design is vital to assure the workload reduces when applying digital communication rather than increases.

## DELIVERY OF THE INFORMATION

The added benefit of digital communication is having the information in standardised structure, ensuring that the same information is available to all actors when required and designed in a way to minimise misinterpretations and to provide common situational awareness. This includes machine-to-machine communications between VTS, vessels and other external sources.

Digital communications should have the same communication procedures as the voice communications where applicable. Digital communication should be processed according to IALA GL1132 VTS Voice Communications and Phraseology where applicable.

To achieve closed-loop communication in digital communications different types of responses should be implemented such as:

* Delivered: system acknowledges message delivery
* Received: human or system acknowledges message reception
* Approved: human or system approves the content of the message

In Figure 2 a typical communication sequence is presented by means of a time sequence diagram explaining the sequence of message exchanges between VTS and vessel(s). Time progresses from left to right in the figure. In this example, it shows the arrival of a vessel through a VTS area towards a berth. VTS represents the top line and the vessel the bottom line in the figure. The arrows depict the messages being transferred between VTS and vessel(s) as time progresses. In the document “Use Cases for VTS Digital Communications”, on the IALA website, the specific message exchange is explained by such time sequence diagrams for the specific functions and services. Kuva, joka sisältää kohteen teksti, kuvakaappaus, Fontti, viiva

Tekoälyllä luotu sisältö voi olla virheellistä.

Figure 2 Example of Communication Principle

**4.3 TECHNICAL INFRASTRUCTURE**

Digital communications require technical solutions that are different and more complex than technical infrastructure needed for traditional communication methods like VHF voice. Technical infrastructure for digital communications consists of various technical building blocks but also immaterial assets like specifications, data models and harmonised ways to manage technical services and underlying platforms. Figure 3 shows a simplified view of technical services related to VTS digital communications.

Kuva, joka sisältää kohteen kuvakaappaus, teksti, muotoilu

Tekoälyn generoima sisältö voi olla virheellistä.

Figure 3 High level view on the Digital Delivery of VTS Information

The digital communication for VTS should reach beyond single VTS area or be ideally even globally accessible. The technical services that implement digital communications for VTS should be standardised, secure and robust as described in section 4.1. All these can be achieved by establishing technical infrastructure according to Service Oriented Architecture (SOA) principles. The implementation of VTS digital communications requires at least following building blocks:

1. Harmonised way to describe technical services and link them to relevant data models according to IMO resolution MSC.467(101) “Guidance on the definition and harmonisation of the format and structure of maritime services in the context of e-navigation’”

2. Unified and global data models that are compliant with IMO’s Common Maritime Data Structure (CMDS)

3. Global and unique identifiers for data and any maritime resource using MRNs

4. Service platform supporting maritime SOA architecture and service provision

5. Data exchange infrastructure to facilitate the real-time and cyber secure data exchange using standardised data transport mechanisms

IALA and other maritime organisations have developed extensive guidance to support implementation of these requirements in harmonised way. The most relevant guidelines and standards for the building blocks mentioned above are as follows:

1. IALA Guideline G1128 The Specification of e-Navigation Technical Services

2. IHO S-100 Universal Hydrographic Data Model and IALA Guidelines G1088 Introduction to Preparing S-100 Product Specifications and G1106 Producing an IALA S100 Product Specification

3. IALA Guideline G1143 Unique Identifiers for Maritime Resources

4. IALA Guidelines G1157 Web Service Based S-100 Data Exchange and G1161 Evaluation of Platforms for the Provision of Maritime Services in the Context of e-Navigation

5. The data exchange itself can be implemented using various industrial standards. The most relevant in the context of VTS digital communications are SECOM (IEC 63173-2), MMS (RTCM standard 13900.0 for Maritime Messaging Service Architecture and Protocol) and VDES VDE (IALA Recommendation R1007 The VHF Data Exchange System (VDES) For Shore Infrastructure)

# PART B VTS DIGITAL FUNCTIONS AND SERVICES

This paragraph will describe the operational descriptions for potential services identified in the domain of Maritime Services in the context of e-Navigation. The operational functions/services are not limited, if needed further functions/services can be added. A local implementation of a function may include all, or subset of, underlying services. Before implementation of digital services, a risk assessment should be carried out.

The Maritime Service for VTS includes several different potential operational functions associated with this Maritime Service. These operational functions can be divided into VTS-specific services and services developed within other Maritime Services. This guideline only focuses on the VTS specific operational functions under the remit of IALA; MS 1 VTS. Development of technical services is out of scope of this guideline. Operational functions are divided in services (Figure 4). These services are worked out in use cases that can be found in the IALA website under the “Topical Matters”.

Kuva, joka sisältää kohteen teksti, kuvakaappaus, ohjelmisto, Tietokonekuvake

Tekoälyllä luotu sisältö voi olla virheellistä.

Figure 4 Detailed illustration of different levels of services in relation to the document context

Technical services are needed to coordinate a seamless combination between different product specifications. Information provided using S-100 based product specifications is brought together by technical services to deliver a Maritime Service. IALA G1128 gives guidance on how to make specifications of Technical Services. A Maritime Service can be implemented by one or more Technical Services and one technical service can implement multiple operational functions.

## PUBLISHING INFORMATION ON VTS DIGITAL SERVICES

The number and type of digital services may vary between different Vessel Traffic centers. Mariners should have access to information about which digital services are available at each VTS. Additionally, VTS digital services should be compatible with and supported by on-board systems.

## VTS SPECIFIC OPERATIONAL SERVICES

VTS specific operational services provide structured methods for exchanging data between vessel(s) and VTS. VTS specific operational functions and services are described in this section. Detailed use cases can be found in a separate document on the IALA webpage (Topical Matters), while the principles for information exchange are provided in Section 4.2 (Delivery of the Information) of this Guideline.

Currently identified VTS specific Operational functions are:

* Route Functions
* VTS Information Functions
* Traffic Functions
* Planning Functions

### ROUTE FUNCTIONS

Route Functions consist of services that enable the exchange of routes, the provision of reference routes, the crosschecking of planned routes in relation to conditions in the VTS area, and the monitoring of vessel movements in accordance to their planned routes. These services provide a structured way for vessels and VTS to share, verify, and oversee navigational information to support safe and efficient maritime traffic.

#### ROUTE EXCHANGE SERVICE

The Route Exchange Service enables vessels and VTS to share planned routes and schedules in a standardised format. By exchanging route information, vessel and VTS share a common understanding of navigational intentions, supporting safe and efficient vessel traffic, while also reducing VHF communication load within the VTS area. Furthermore, the Route Exchange Service is the base for other route-related services such as Route Monitoring, Route Crosscheck, and Route Reference.

#### ROUTE REFERENCE SERVICE

With the Route Reference Service VTS and other service providers offer routes and waypoints, in electronic format. Route Reference Service is designed to assist mariners in their voyage planning to define the suitable route on commonly used passages, such as shipping lanes, approaches to ports, and coastal routes. Reference routes can be fully predefined and/or can be calculated based on predefined waypoints.

#### ROUTE CROSSCHECK SERVICE

The purpose of Route Crosscheck Service is to validate a planned or monitored route from the vessel and compare the information with expertise of the VTS and its information regarding the specific VTS area (traffic separation, depth, speed restriction, etc). When the VTS receives a route from a vessel the VTS should be able to execute a Route cross check. The cross-checking may be done before the vessel’s departure or before arrival at a certain geographical area (for example a VTS area). The cross-check may include Under Keel Clearance, air draft, no violation of no-go areas, Maritime Safety Information and compliance with mandatory routing.

#### ROUTE MONITORING SERVICE

The Route Monitoring Service is used to monitor vessels´ movement in vicinity and in the VTS area. Within this service the VTS may detect vessel´s deviating from their routes or schedules, allowing the VTS to intervene promptly in case of potential safety hazards and navigational issues.

### VTS INFORMATION FUNCTIONS

VTS Information Functions include services that enable the exchange of information between vessels and the VTS. Services contain the reporting and the provision of structured and unstructured navigational and traffic-related information. These functions ensure that accurate, timely, and relevant information is shared to enhance situational awareness, support safe and efficient navigation.

#### VTS REPORTING SERVICE

The VTS Reporting service is designed for vessels to report information to the VTS as specified by theVTS. This includes an arrival/departure report, position report and specific information about the vessel which affects ships traffic.

#### VTS INFORMATION SERVICE

The primary purpose of the VTS Information Service is to support the safe navigation of vessels within and outside the VTS area by providing relevant information. This may include details on uncharted obstacles, traffic conditions, pilotage, or general operations. The service can deliver both structured and unstructured information, with all messages beginning with a message marker.

### TRAFFIC FUNCTIONS

Traffic Functions consist of services that enable the exchange and sharing of real-time traffic information between vessels and VTS. Services include the provision of a common traffic image, the exchange of intended tracks, and navigation assistance. Together, these services enhance situational awareness, reduce the risk of collisions, and allow timely communication of information to ensure safe and efficient vessel movements within the VTS area. Services ensure that vessel(s) and VTS have a common understanding of the traffic situation, enabling timely decisions and actions to maintain navigational safety.

#### TRAFFIC IMAGE SERVICE

The Traffic Image Service enables the exchange of real-time traffic information between VTS and vessels. For example using sources like AIS, radar, or CCTV, it provides vessels and VTS with an up-to-date traffic picture and supports the creation of a common traffic image within the VTS area.

#### INTENDED TRACK EXCHANGE SERVICE

The intended track exchange service is designed to (automatically) broadcast the intended trajectory of the vessel covering a route segment of a certain amount of time which is significantly shorter than the complete planned route (minutes rather than hours). This intended trajectory may consist of the current track and speed or a limited set of waypoints of the route including time at each waypoint. Depending on the applied control of the vessel, for example: manual control, autopilot or track pilot it broadcasts the track and speed or a set of waypoints. Vessels share their intentions from vessel to vessel as well as from vessel to VTS. This allows vessels to avoid potential conflicts because this service provides the vessels insight in the developing traffic situation. With this service, the VTS receives all vessels intentions within the VTS area, allowing the VTS to intervene promptly in case of potential safety hazards and navigational issues.

#### NAVIGATION ASSISTANCE SERVICE

The Navigation Assistance Service supports VTS in responding to developing unsafe situations. These situations may include a vessel unsure of its position, deviating from its route, needing guidance to anchorage, experiencing equipment failure, facing severe weather, being at risk of grounding or collision, or requiring emergency support. The service provides navigational information, advice, warnings or instructions to individual vessels or to groups within the VTS area. All messages are transmitted reliably to ensure that vessels receive them and can maintain safe navigation.

### PLANNING FUNCTIONS

Planning Functions consist of services that support the safe and efficient planning of vessel movements within a VTS area. Services include providing traffic clearance to ensure safe passage and allocating time slots for arrivals, departures, or transits. These services allow VTS to coordinate traffic flow, prevent congestions and/or conflicts, and optimise the safe and efficient use of the VTS area.

#### TRAFFIC CLEARANCE SERVICE

Traffic clearance refers to the process of ensuring that there is sufficient space and time for vessels to navigate safely through an area, taking into account other vessels, obstructions, regulatory and environmental factors. The Traffic Clearance Service provides vessels with permission to proceed, set conditions and/or denies clearance. Within this service the VTS coordinates, authorises, and monitors the approach and passage of vessels through the areas.

#### SLOT MANAGEMENT SERVICE

The Slot Management Services is designed to provide a time slots for vessels in advance to ensure safe, efficient, and organised movement within the VTS area. A time slot includes scheduling and allocation for vessel(s) within a VTS-area. The service includes assigning specific time slots for vessels' arrival, departure, or transit. The time slot may be based on for example weather and/or hydrologic conditions (for example tide, fog), port/area resources (for example berth, anchorage), traffic density, infrastructure (for example bridge, lock), type/size of vessel. This integrated approach enables the VTS to manage traffic flow while maintaining safety and operational efficiency.

## examples how to use operational functions

Figure 5 to 8 show four examples of the applicability of the various operational functions of digital communication. At the bottom of the figure the vessel voyage is indicated where the voyage progresses from left to right. The dark blue at the bottom stands for the vessel sailing outside the VTS area, the light blue stands for the VTS area with or without an anchoring area and the yellow part is the port of arrival or departure. The different coloured bars above indicate in which phase of the voyage the various services of the four functions can become relevant and can be applied.

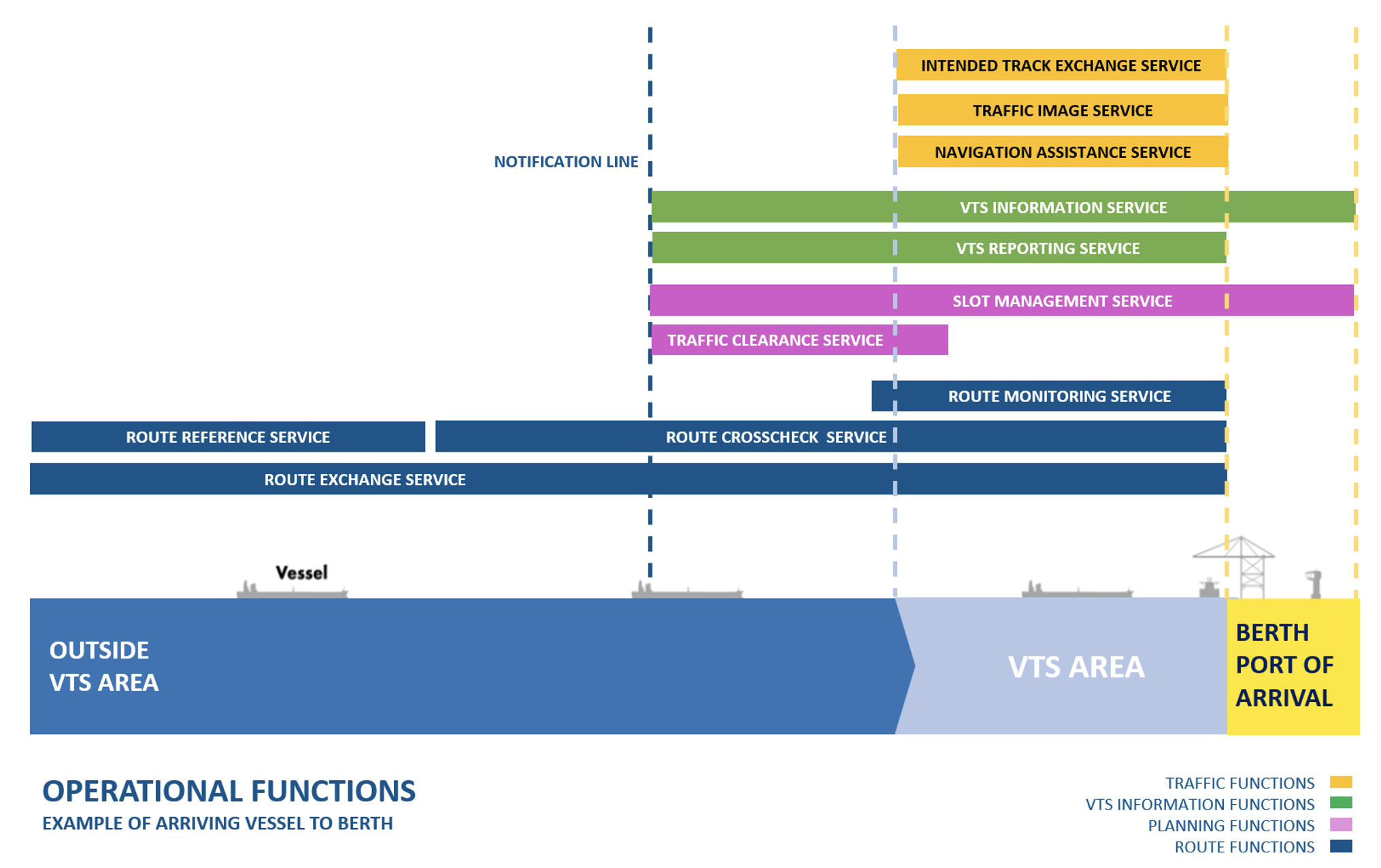


Figure 5 Example of different services when vessel is arriving to port

Kuva, joka sisältää kohteen teksti, kuvakaappaus, Fontti, viiva

Tekoälyllä luotu sisältö voi olla virheellistä.

Figure 6 Example of different services when vessel is arriving to anchorage area

Kuva, joka sisältää kohteen teksti, kuvakaappaus, Fontti, muotoilu

Tekoälyllä luotu sisältö voi olla virheellistä.

Figure 7 Example of different services when vessel is transiting VTS area

Kuva, joka sisältää kohteen teksti, kuvakaappaus, Fontti, Verkkosivusto

Tekoälyllä luotu sisältö voi olla virheellistä.

Figure 8 Example of different services when vessel is departing from port

# ABBREVIATIONS

AIS Automatic Identification System

CCTV Closed-Circuit Television

CMDS Common Maritime Data Structure

IMO International Maritime Organisation

HMI Human Machine Interface

JIT Just in Time arrival

MASS Marine Autonomous Surface Ship

MRN Marine Resource Name

MS Maritime Service in the context of e-navigation

MSC Maritime Safety Committee

MSI Maritime Safety Information

SOA Service Oriented Architecture

VHF Very High Frequency

VTS Vessel Traffic Service

VTSO Vessel Traffic Service Operator

# REFERENCES

IMO MSC.1-Circ.1610-Rev.1 Descriptions of Maritime Services in the Context of E-Navigation

IMO Resolution A.1158(32) Guidelines for vessel traffic

IMO circular MSC.1/Circ 1595 E-navigation strategy implementation plan – update 1

IALA Guideline G1182 Cyber Security Specifics from an IALA Perspective

IALA Guideline G1132 VTS Voice Communication and Phraseology

IMO resolution MSC.467(101) Guidance on the definition and harmonization of the format and structure of maritime services in the context of e-navigation

IALA Guideline G1128 The Specification of e-Navigation Technical Services

IHO S-100 Universal Hydrographic Data Model

IALA Guideline G1143 Unique Identifiers for Maritime Resources

IALA Guidelines G1157 Web Service Based S-100 Data Exchange

IALA Guideline G1161 Evaluation of Platforms for the Provision of Maritime Services in the Context of e-Navigation

IALA Guidelines G1088 Introduction to Preparing S-100 Product Specifications

IALA Guideline G1106 Producing an IALA S100 Product Specification

IALA Guideline G1089 Provision of a VTS