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| IALA Guideline |

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[VTS INTERACTION WITH A MIX OF CONVENTIONAL, AUTOMATED AND AUTONOMOUS SHIPS]

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Table of Contents

[1. introduction 4](#_Toc175303281)

[2. document purpose 4](#_Toc175303282)

[2.1. Using this Guideline 4](#_Toc175303283)

[2.2. Relationship to other documents 5](#_Toc175303284)

[3. IMO regulatory framework 6](#_Toc175303285)

[4. PROVISION OF VTS with A DYNAMIC MIX OF CONVENTIONAL, AUTOMATED AND AUTONOMOUS SHIPS 6](#_Toc175303286)

[4.1. SITUATIONAL AWARENESS 7](#_Toc175303287)

[4.1.1. VTS 8](#_Toc175303288)

[4.1.2. Participating Ships 8](#_Toc175303289)

[4.2. INTERACTION 9](#_Toc175303290)

[4.2.1. Introduction 9](#_Toc175303291)

[4.2.2. VTS 9](#_Toc175303292)

[4.2.3. Participating Ship 9](#_Toc175303293)

[4.3. MANAGING A MIX OF CONVENTIONAL, AUTOMATED AND AUTONOMOUS SHIPS 10](#_Toc175303294)

[4.3.1. VTS 10](#_Toc175303295)

[4.3.2. Participating Ships 11](#_Toc175303296)

[4.3.3. Emergency Response for MASS 11](#_Toc175303297)

[5. Moving Forward 11](#_Toc175303298)

# introduction

Interaction between VTS and ships is transitioning from being primarily by VHF voice towards more digital forms. With the increasing use of automation and autonomy in how ships are navigated, controlled, and operated a new approach is required as to how interaction and situational awareness is achieved by both VTS and participating ships (i.e., Master/ Master of a MASS / ROC).

# document purpose

The purpose of this document is to assist VTS providers prepare for interacting with ship traffic comprising a dynamic mix of conventional, automated and autonomous ships.

The interaction should be in a manner that ensures VTS achieves its purpose of contributing to the safety of life at sea, improves the safety and efficiency of navigation and supports the protection of the environment within a VTS area by mitigating the development of unsafe situations through:

* providing timely and relevant information on factors that may influence ship movements and assist onboard decision-making.
* monitoring and managing ship traffic to ensure the safety and efficiency of ship movements.
* responding to developing unsafe situations.

Specifically, the document addresses practices to be considered when managing ship traffic and responding to developing unsafe situations in a VTS area with increasing automated, remote control, or autonomous operation of on-board functions that are not adequately or fully addressed in other IALA recommendations and guidelines.

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| IALA Guideline XXXX - <Title> is associated with IALA Recommendation R0127 - VTS Operations.  Recognizing the MASS Code adopted by IMO on <Date> is voluntary, Guideline XXXX is informative in nature and describes additional desirable practices for interacting with ship traffic comprising a dynamic mix of conventional, automated and autonomous ships.  It is not necessary to conform to in order to claim compliance with Recommendation R0127.  *Note: With the evolution of MASS and entry into force of the mandatory MASS Code in 2032 it is expected this guideline will be reviewed and updated regularly.* |

## Using this Guideline

IALA standards, recommendations and guidelines specifically related to the establishment and operation of VTS have historically been developed on the basis that:

* Ships have at least a minimum level of manning on board to carry out the various tasks required to ensure safe, secure, and environmentally sound ship operations; and
* The interaction between VTS and ships is by VHF voice and, as a result, all traffic and VTS maintain situational awareness by being aware of each interaction between VTS and individual ships.

The increasing use of automation in the operation of ships, along with the anticipated increase in the use of remote control and autonomous operation of key functions, requires a different approach. Changes to the accepted norms for interaction to provide information, or issue advice, warnings, and instructions to manage ship traffic and respond to developing unsafe situations are therefore required.

This Guideline has been prepared in a manner that:

* A diagram of a ship

  Description automatically generatedRecognizes the evolution of automation and autonomy in the context of how ships are navigated, controlled, and operated over the next twenty years.

Noting the distinction between automation and autonomy in the context of ship operations identified in IALA document *The Future MASS* the focus of Version 1 of this Guideline is focused on the short-term (1-10 years) and the Scenario of “Many crewed ships with automated functions”.

* Recognizes the operational requirements to manage ship traffic comprising a mix of conventional ships, automated and autonomous ships may not be adequately addressed in existing IALA standards, and additional guidance is required to achieve a level of safety that is equivalent to that traditionally expected.
* Identifies additional desirable practices to interact and manage ship traffic comprising a dynamic mix of conventional, automated and autonomous ships insofar as they are not adequately or fully addressed in other IALA recommendations and guidelines.
* Recognizes certain operational functions associated with a ship’s operation may be controlled automatically/autonomously, either onboard or from a location, or locations remote from the ship.
* Recognizes that VTS often has greater information / situational awareness than any ship in the VTS area, regardless of its type.
* Provides a framework for VTS providers to adapt their processes and systems to ensure interaction continues to facilitate situation awareness both within the VTS and between VTS, allied services, automated systems, Master / Master of a MASS.

## Relationship to other documents

This Guideline should be read in conjunction with:

1. **IALA Standard 1040 Vessel Traffic Services** - extensive guidance is provided on practices for the day-to-day operation of VTS, interacting with ship traffic and situational awareness in:

* VTS operations - *Recommendation 0127 – VTS Operations*, including:
  + *Guideline 1089 - Provision of a VTS.*
  + *Guideline 1141 - Operational Procedures for Delivering VTS.*
  + *Guideline 1110 - Use of Decision Support Tools for VTS Personnel*.
* VTS Communications - *Recommendation 1012 – VTS Communications*. In particular:
  + *Guideline 1132 VTS Voice Communications and Phraseology.*
  + *Guideline XXXX - VTS Digital Communications.*
* VTS Technologies - *Recommendation 0128 - VTS Systems and Equipment.* Specifically:
  + *Guideline 1111 - Establishing Functional and Performance Requirements for VTS Systems and Equipment.*
* VTS Data and Information Management - *Recommendation 0125 - VTS Portrayal.* Specifically:
  + *Guideline 1177 - Portrayal of VTS Information*.
* Guideline XXXX - Developments and implications of maritime autonomous surface ships for coastal authorities

1. **The IMO MASS Code and relevant conventions**, as amended.
2. **S-100 based Product Specifications**

<to follow>

# IMO regulatory framework

To ensure the IMO regulatory framework for shipping keeps pace with rapidly evolving technological developments associated with MASS, the IMO has adopted a goal-based instrument (MASS Code). Specifically, the Code:

* Supplements other IMO instruments such as SOLAS.
* Provides a regulatory framework for the performance of remote control and autonomous operation of key functions, as applicable.

The IMO aims to have a non-mandatory MASS Code adopted in the 1st half of 2025, with a mandatory Code entering into force on 1 January 2032.

Key milestones remaining to achieve this include:

| **MSC 109**  **2nd half 2024** | **MSC 110**  **1st half 2025** | **1 July 2026** | **1 January 2032** |
| --- | --- | --- | --- |
| Finalization and adoption of the new non-mandatory MASS Code  Finalization and approval of amendments to existing instruments necessary for the entry into force of the new instrument | Adoption of a mandatory MASS Code and associated Convention(s) giving effect to the new MASS Code | Deadline for adoption for entry into force date of 1 January 2028 | Entry into force of Mandatory Code[[1]](#footnote-1) |

The Code is considered to provide the framework for MASS to operate within the same framework and responsibilities of conventional ships.

# PROVISION OF VTS with A DYNAMIC MIX OF CONVENTIONAL, AUTOMATED AND AUTONOMOUS SHIPS

VTS is recognised internationally as a navigational safety measure through the SOLAS Convention.

The purpose of VTS is to contribute to the safety of life at sea, improve the safety and efficiency of navigation and support the protection of the environment within a VTS area by mitigating the development of unsafe situations through:

* providing timely and relevant information on factors that may influence ship movements and assist onboard decision-making.
* monitoring and managing ship traffic to ensure the safety and efficiency of ship movements.
* responding to developing unsafe situations.

As stated in IMO Resolution A.1158(32), *“To achieve their purpose, VTS should provide information or issue advice, warnings and instructions, as deemed necessary”.*

Implicit in achieving its purpose is the capability to:

* Maintain situational awareness through:
* Information and reports from individual ships such as route information, course and speed, attributes, cargo, and communication methods.
* Information and reports from allied services associated with ship movements and other factors influencing the waterway.
* Sensors (for example radar, AIS, etc).
* The use of decision support tools to manage identified risks, support VTS personnel providing timely and relevant information, monitor and manage ship traffic, and respond to developing unsafe situations.
* Interact with individual ships as deemed necessary, on request from a ship or as a matter of procedure.
* Broadcast information to all ships.

Key considerations in the transition to a mix of VHF voice communication and digital communications include:

* A diagram of a diagram of a situational awareness

  Description automatically generated**Situational Awareness** - Ensuring situational awareness from both the perspective of VTS and participating ships (i.e., the Master / Master of a MASS) is achieved.
* **Interaction** – Interaction between the VTS and participating ships is undertaken in a manner that the intent of messages conveyed to participating ships is the same, irrespective of whether the communications is by VHF voice, digital means, or both.
* **Management -** Systems, processes, and procedures to ensure capability to interact by VHF Voice, digital means, or both when managing ship traffic and responding to developing situations.

These are interrelated and are critical to monitor and manage ship traffic comprising a dynamic mix of conventional, automated and autonomous ships to ensure the safety and efficiency of ship movements through the provision of information or issue advice, warnings, and instructions.

## SITUATIONAL AWARENESS

A key factor in maintaining the safety and efficiency of navigation and support the protection of the environment within a VTS area is for both the VTS and individual ships (conventional, automated and autonomous) to maintain situational awareness.

The International Dictionary of Marine Aids to Navigation defines situational awareness as:

*Situational awareness refers to the ability to identify, process, and comprehend the critical elements of information about what is happening in the surrounding environment at any given time.*

*It involves being aware of what is happening around you and understanding how that information, events, and your own actions will impact your goals and objectives, both immediately and in the near future.*

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| **Note - MSC 108-WP.7**  **CHAPTER 4 TERMINOLOGY AND DEFINITIONS**  **4.45 Situational Awareness**  *[The classification of situational awareness capabilities should be categorized by mode of operation because the details of situational awareness will vary depending on the subject for which it is provided (crew, remote operators, and so on) and the functionality should differ. (MSC 107/5/7)*  *Situational Awareness* means the perception of environmental elements and events with respect to time or space, the comprehension of their meaning, and the projection of their future status (Endsley 1995). (RBAT)]  **4.7 Autonomous Navigation System**  [*Autonomous Navigation System* (ANS) means a system which has the functionalities of situational awareness, route planning and determination for collision and grounding risk avoidance, shipʹs heading, speed and track control, etc. (MSC 107/5/10) |

The transition to interaction being conducted by both traditional VHF voice and digital means needs to be managed in a way that ensures situational awareness is effectively achieved from both the perspective of VTS and participating ships (i.e., the Master/ Master of a MASS). Refer to Section 4.3.

### VTS

In addition to sensors (e.g., radar, AIS, etc) to monitor transiting ships (position, course, etc), VTS has traditionally achieved situational awareness through:

* Voice communications to:
  + Receive information and reports from individual ships such as route information, course and speed, attributes, cargo, and communication methods.
  + Receive information and reports from allied services associated with ship movements and other factors influencing the waterway.
* Decision support tools to manage identified risks, support VTS personnel provide timely and relevant information, manage ship traffic, and respond to developing unsafe situations.

Key considerations to maintaining situational awareness with a dynamic mix of conventional, automated, and autonomous ships include the capability to:

1. Receive information and reports from participating ships as required by the VTS such as route information, course and speed, attributes, cargo, defects, and communication methods by both VHF voice and digital means or both.
2. Maintain real time awareness of and acknowledge information about:

* Who is in command of the ship.
* Communications technology / medium to interact with the ship at all times.
* Current degree of autonomy.

With the increasing use of automation and autonomy in how ships are navigated, controlled, and operated, VTS will need to have the capability to interact with ships by both VHF voice and by digital means, or a combination of the two (See Section 4.2).

### Participating Ships

Traditionally, VTS has contributed to the situational awareness of ship masters / bridge team by providing timely and relevant information on factors that may influence ship movements and assist onboard decision-making through VHF Voice communications.

The use of simplex VHF channels has ensured that all participants are able to monitor exchanges between each other and the VTS centre. That is, both sides of any exchange are heard by all other ships.

Ensuring both sides of any exchange are heard by all other ships when interaction is by digital means needs careful consideration. It is vital to ensure all parties receive relevant information on factors that may influence their movements and onboard decision-making. Information should be in a timely manner with the increasing use of automation and autonomy in how ships are navigated, controlled, and operated requires careful consideration (See Section 4.2).

## INTERACTION

VTS and participating ships should have the capability to interact with each other by VHF voice, as well as digital means, to:

* **Receive** reports or information from ships as required by VTS.
* **Provide** ships with information on factors that may influence ship movements and assist “onboard” decision making.
* **Issue** advice, warnings, and instructions to manage traffic and respond to developing situations.

### Introduction

Significantly, interaction by digital means will include system-to-system, person-to-system, and system-to-person communication.

This requires not just embracing individual technologies but implementing systems, processes, and procedures to manage dual communication means. All communication should be undertaken in a manner that ensures the interaction achieves the same meaning and intent to all participating ships, irrespective of the communications medium, and supports situational awareness.

With the transition to digital interaction, it is important to recognise the use of the term’s ‘*interaction’* and ‘*communication’*, noting the IMO resolution for VTS uses the term ‘*interaction’* in the definition of VTS. That is:

‘*the capability to interact with vessel traffic and respond to developing situations’*

It is generally accepted that:

* Communication - refers to the act of sharing information.
* Interaction - refers to acting in such a manner so as to affect the other.

The key difference between ‘*communication’* and ‘*interaction’* is that ‘*interaction’* is a broader term while ‘*communication’* is a part of the ‘*interaction’.*

### VTS

VTS should have the capability to interact by traditional means (VHF voice), digitally or both with participating ships through a standardized message structure (data elements, format, syntax) and phrases to:

* Facilitate clear, concise, and unambiguous interactions that are efficient, effective, and timely.
* Ensure the same meaning and intent of interactions is communicated to all participating ships, irrespective of the communications medium.
* Ensure the digital communication is aligned with the practices described in *G1132 – VTS Voice Communications and Phraseology and GXXXX - VTS Digital Communications*.
* Acknowledging information and data received.

The capability should include interaction activities such as those described in Annex A.

### Participating Ship

Participating ships should, as stated in IMO Resolution 1158(32) have the capability to provide reports or information required by VTS and to take into account the information provided, or advice, warnings and instructions issued.

Participating ships should have the capability to interact by traditional means (VHF voice), digitally or both with the VTS through a standardized message structure (data elements, format, syntax) and phrases as described in 4.2.2

## MANAGING A MIX OF CONVENTIONAL, AUTOMATED AND AUTONOMOUS SHIPS

The increasing use of automation and autonomy in how ships are navigated, controlled, and operated, will require VTS to have the capabilities to interact with ships by both VHF voice and by digital means to monitor and manage ship traffic and respond to developing unsafe situations. In particular this includes:

* **System Capabilities** – to support interaction and situational awareness. This includes receiving, processing and sending.
* **Processes and Procedures** – to support interaction, situational awareness, and system capabilities.

System capabilities, processes and procedures are interrelated. This Guideline should be considered along with other IALA Guidelines, including *GXXXX Guideline on VTS Digital Communications*, to ensure VTS achieves its purpose in interacting with ship traffic comprising a dynamic mix of conventional, automated and autonomous ships.

### VTS

Key considerations for VTS in interacting with a mix of dynamic mix of conventional, automated and autonomous ships include:

* System Capabilities – (implications for G1111)
* Processes and Procedures (implications for G1141)

1. **System Capabilities**

* Managing a mix of VHF voice, digital communications, and automated data exchange, including:
  + Interacting by both conventional means and digital means with individual ships
  + Managing interaction with multiple ROC’s.
* Capability to receive reports and information from ships digitally and in a manner that is assimilated within the VTS system and assimilated within the VTS operational picture and shared with relevant stakeholders in a manner at least as timely as is currently achieved.
* Capability to know, where a ship may be controlled from more than one ROC, the ROC in command of the ship at any time.
* Capability to identify if the ship is conventional, automated or autonomous. If autonomous also the degree of autonomy.
* The Decision Support Tool has the capability to:
  + Monitor the Master / Master of a MASS and associated communications means (voice / digital).
  + Display the Master / Master of a MASS and associated communications method to VTS personnel.

1. **Processes and Procedures**

* Managing interaction to and from participating ships to ensure the message and intent is delivered to all ships as would be the case by VHF voice. This may include interacting both by voice and in parallel by digital means.

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| ***Note*** *–* Guidance on VTS Digital communications being prepared by Working Group 1 (Task 1.3.1) includes operational descriptions and use cases for the potential technical services identified in the description for Maritime Service for VTS such as:   * Voyage Information Service - The service supports exchange of voyage plans, text messages and area messages. * Route Information Service - The service provides route recommendations and/or route validation for ships. * Traffic clearance Service - The service provides vessels with permission to proceed, impose conditions or deny clearance.   S 100 product specifications |

### Participating Ships

Participating ships include ships required to participate with vessel traffic services as described in:

* SOLAS V12 - 4 Contracting Governments shall endeavour to secure the participation in, and compliance with, the provisions of vessel traffic services by ships entitled to fly their flag..; and
* Ships required to participate with vessel traffic services as described in IMO Resolution A.1158(32)

### Emergency Response for MASS

[VTS must adapt its emergency response protocols to address the unique challenges posed by MASS. This includes the use of real-time risk assessment tools and automated alert systems. VTS operators should be trained to manage emergencies that require immediate human judgment, ensuring effective coordination with ROCs and other stakeholders.]

# Moving Forward

The intent is to update this Guideline based on the practical experience of VTS providers deriving from the adoption of the non-mandatory MASS Code and Test-bed information provided to IALA. (Ref: IALA *Guideline G1107 – Planning and Reporting Testbeds on the Maritime Domain*)

* + 1. **Phase-Specific Integration**

[As the maritime industry moves towards higher levels of vessel autonomy, VTI operations must adapt to each phase of MASS development. This guideline provides phase-specific recommendations to address the evolving needs of VTS, from remotely operated vessels to fully autonomous ships, ensuring that VTS remains effective and responsive throughout this transition.

**Routine Interaction Activities**

**Note**

The concept of “Routine Interaction Activities” - Table taken from Input Paper *VTS55-10.1.4.1 Draft Guideline on Task 3.8.8 VTS English Language Competency Test*

To be updated as TG3.8.8 develop this table further

| **Interaction Activities** | **Examples** |
| --- | --- |
| Pre-arrival information | * Receive pre-arrival information from ship * Request any outstanding information from ship / allied services (e.g. agents) to ensure compliance with reporting requirements * Issue arrival instructions * Inform allied services/pilotage providers of ships intended arrival |
| Vessels entering VTS area | * Receive entry report from ship with route or passage plan information * Query if the ship has any defects or deficiencies, such as navigation or manoeuvring equipment failure * Inform of relevant traffic and navigational information * Inform of berthing/anchorage details * Inform of pilotage requirements * Issue instructions not to proceed past pilot boarding grounds without pilot * Receive /acknowledge notification of pilot onboard |
| Monitor and manage vessels in the VTS area | * Inform of relevant traffic and navigational information * Inform ship with other requested information * Receive / acknowledge notification of pilotage movements (e.g. onboard/disembark) * Inform of activities that may interfere with the flow of ship traffic such as nautical activities (e.g. sailing regattas) or marine works in-progress (such as dredging, submarine cable-laying) * Issue permission to conduct special activities (e.g. hot works, lifeboat drills, deck wash) * Issue instructions to organise traffic: * To prioritise and forward plan the sequence of movements in the VTS area (e.g. departure from berth, ships transporting special cargo) * To keep clear of special areas, ships, or positions * When a ship has passed a point of no return * When establishing ship safety or exclusion zones * Issue instructions to ensure speed limits are observed * Issue instructions to ensure compliance with the regulatory provisions |
| Responding to developing unsafe situations | * Query ship on their intentions (eg deviation from standard route etc) * Assist a ship: * That has defects or deficiencies, such as navigation or manoeuvring equipment failure. * With navigational information (eg navigating to an anchoring position/ channel/ fairway/ lane, proximity to navigational hazards, providing with range and bearing) * Unsure of its route or position * To support the unexpected incapacity of a key member of the bridge team * Issue advice/ warning/ instruction to a ship * They are deviating from the planned or recommended route towards shallow water, dangerous wrecks or other obstacles not otherwise promulgated * Are at risk of grounding or collision * To alter the course, speed * To close up/drop back on/from another ship * To keep clear from area/position * Inform of meteorological conditions (e.g., low visibility, strong winds) * ~~Assist in emergency response or support to emergency services~~ |
| Vessels at anchor | * Issue instruction to anchor in a nominated position/specified location * Issue advice/ warning/ instruction not to anchor in a nominated position/specified location * Request ship to report when ship is at anchor, or dropped anchor * Assist ships into anchorage position * Request ship to weigh or heave up anchor at a specified time / report to VTS * Receive permission to proceed request when ship is ready to leave anchorage * Issue permission for a ship to proceed from anchorage * Deny permission for a ship to proceed from anchorage * Request ship to report when the anchor is clear of the water and underway * Inform of relevant traffic and navigational information to the ship prior to departure * Advise ship they are dragging anchor and request to check position of its anchor * ~~Information exchange/update with allied services~~ |
| Vessels at berth | * Inform of reporting requirements and restrictions while at berth * Request ship to report at a specified time before departing * Receive permission to proceed request when ship is ready to depart a berth * Issue permission for a ship to depart a berth * Deny permission for a ship to depart a berth * Request ship to report when ship has singled up, or last line has been let go * Inform of relevant traffic and navigational information to the ship prior to departure * ~~Information exchange/update with allied services~~ |
| Vessels departing the VTS area | * Receive exit report from ship * Inform / remind of reporting requirements with adjacent or next VTS * Receive /acknowledge notification of pilot disembarkation |
| Transition between adjacent VTSs | * Inform adjacent VTS of ship information such as identification, cargo, destination, and ETA |
| Adverse environmental conditions | * Inform / broadcast information on adverse environmental conditions within the VTS area (e.g. poor visibility, strong currents or tidal streams, high winds, ice etc) * Inform of additional reporting requirements * Issue instructions to organise traffic (e.g. restrict or prohibit ship movements, increase separation between ships) * Issue instructions for additional requirements (e.g. mandatory tug service, pilot, etc.) |
| Environmental protections | * Inform / broadcast relevant information to mitigate risks with ships (e.g. cetaceans or marine mammals in an area, impacts of ship wash) * Issue advice/ warning/ instructions to individual ships in the vicinity of an area * Issue instructions to impose speed restrictions in an area or to reduce ship wash * ~~Request information on sightings (e.g. to identify potential interaction hotspots)~~ |
| Interaction with allied services | * Exchange information with allied services such as: * Pilots * Tugs and tug operators * Icebreakers and icebreaker operators * The organizers of marine events * Shipping agents * Government agencies, including law enforcement agencies |
| Emergency response | * Receive / request information about the emergency * Inform response agencies and allied services of emergency * Assist in emergency response or support response agencies * Coordinate communications between ship, response agencies and allied services * Inform or relay information about the emergency with ships in VTS area * Issue instructions to manage and restrict traffic in the area |

1. [↑](#footnote-ref-1)