

**DISCUSSION PAPER**

fUTURE VTS

Edition 1.0

Date (of approval by Committee)

Revisions to this IALA Document are to be noted in the table prior to the issue of a revised document.

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| Date | Page / Section Revised | Requirement for Revision |
| XX <Month> <Year> | Version 1 released |  |
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# INTRODUCTION

Vessel Traffic Services (VTS) is recognised internationally through the International Convention on the Safety of Life at Sea 74/78 (SOLAS) as a navigational safety measure contributing to the safety of life at sea, safety and efficiency of navigation and protection of the marine environment.

The number VTSs implemented throughout the world continues to increase significantly every year as a means to mitigate risk in waterways and contribute to efficiency.

There is also a growing expectation for more proactive management of shipping in response to increasing volumes of traffic, increasing competition for access to waterway space from existing and new stakeholders, changing public expectations and emerging technologies.

In conjunction with emerging developments such as e-Navigation, Sea Traffic Management, Marine Autonomous Surface Ships and Maritime Services this trend will also see changes to how VTS contributes to safe, efficient and secure maritime logistics, improved data exchange between ports and ships, and global standards for the safety, security and efficiency.

In evolving with these developments, it is generally accepted that VTS will increasingly become an information hub, enabling the rapid exchange of data and information between the shore and the ship.

Paragraph on New Resolution – “future proofing” aspects, view to Future VTS (near future and far future)

# DOCUMENT PURPOSE

The purpose of this document is to assist the Committee identify, assess and monitor emerging trends, technologies, practices and developments and strategically plan and coordinate embracing these changes to improve the safety and efficiency of navigation, contribute to the safety of life at sea and support protection of the marine environment.

In particular, the document aims to provide a concise, high level, reference to assist the Committee to:

* Be cognisant of emerging practices, technologies and trends that will affect the provision of VTS.
* Assess and monitor the potential impact, challenges and opportunities for VTS.
* Strategically embrace change and, in particular, how existing VTS practices could be enhanced, potential new practices adopted
* Plan for the future through, for example:
  + Adopting future work programme tasks.
  + Facilitating necessary changes to IALA Standards relating to VTS or the international legal and regulatory framework for VTS.
  + Managing any practical issues and challenges in transitioning to a more proactive role for VTS in the future.
  + Liaison/engagement with other bodies.
  + Engaging and communicating with all stakeholders and the public.

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| As a ‘living document’, it is intended that the document will reviewed/updated by the Committee at each meeting and updated as appropriate. |

# EXECUTIVE SUMMARY

The International Maritime Organization (IMO), in its role in regulating the planning, implementation and operation of vessel traffic services, is responsible for providing guidance on its establishment, operation, qualification and training (IMO Resolution XXX Vessel Traffic Services. In particular the resolution:

* Defines VTS as a service “*implemented by a Government with the capability to interact with vessel traffic and respond to developing situations*”.
* States that the purpose of VTS is to “*contribute to safety of life at sea, safety and efficiency of navigation and the protection of the environment within the VTS area by mitigating the development of unsafe situations through*”:
  + “*the provision of timely and relevant information on factors that may influence the ship's movements and assist on-board decision making*”;
  + “*the monitoring and management of ship traffic to ensure the safety and efficiency of ship movements*”; and
  + “*responding to developing unsafe situations*”.
* Recognises IALA’s contribution to the development of internationally harmonized guidance for vessel traffic services through its standards and associated recommendations, guidelines and model courses specifically related to the establishment and operation of VTS.

Globally, there is a trend for more proactive management of shipping in response to increasing volumes of traffic, emerging technologies and practices, increasing competition for access to waterway space from existing and new stakeholders, and changing public expectations.

The trend will inevitably see changes to how VTS contributes to safe, efficient and secure maritime logistics, improved data exchange between ports and ships, and global standards for the safety, security and efficiency.

This document explores how VTS can embrace these changes and, in particular, how existing VTS practices can be enhanced, new practices adopted and how the practical issues and challenges in transitioning to a more proactive role for VTS in the future.

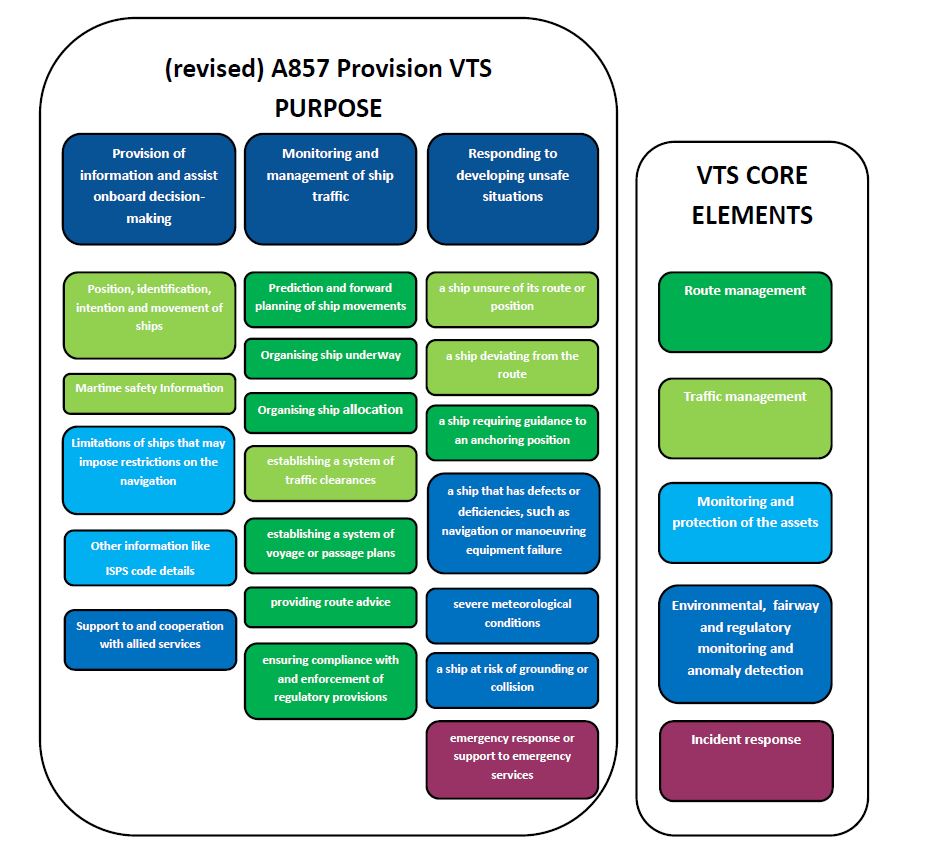
Future VTS will be more about ensuring that vessels have a secured and proper information position by enabling digital information exchange and automated interaction, monitoring and managing traffic for safe and efficient ship movements and advanced detection systems for developing unsafe situations. In summary, these include three themes:

* Digital situational awareness
* Interacting objects
* Advanced decision support

This document identifies practices, technologies and trends considered as emerging developments that have implications for the capabilities of a VTS, its purpose and possibly the existing international regulatory framework and associated Standards.

These developments and their relationships are summarised below:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **VTS AND EMERGING DEVELOPMENTS** | | | | |
| **WHAT IS VTS**  **(SOLAS)** |  | **HOW DOES VTS CONTRIBUTE**  **(IMO Resolution)** | | |
| **Contributes to:** | **Capability** |  | **Purpose/Actions** |
| * Safety of Life At Sea * Safety of Navigation * Efficiency of Navigation * Protection of the Marine Environment | * **Interact** with vessel traffic * **Respond** to developing situations within a vessel traffic service area |  | * **Assist on-board decision making** * **Management of ship traffic** * **Responding to developing unsafe situations** |
| **Emerging practices, technologies and trends** | | |
| **Practices**   * Maritime Autonomous Surface Ships * Just in Time / Slot Management * Navigational Assistance * Role of VTS * Route Management   **Trends**   * Green House Gas Polices * Coastal / Regional VTS * Beyond territorial seas * Marine Spatial Planning |  | **Technologies**   * Digital situational awareness / Common Situational awareness * Interacting Objects * Advanced Decision Support Services * Digital technologies and communications * Automated Data and Information Exchange * New sensing technology for nearshore and port waters * Long-distance sensing technology |



Text from Peter E on possible structure

|  |
| --- |
| **5. Emerging Maritime Policy Drivers**  5.1 IMO Greenhouse Gas Strategy  5.2 Marine Autonomous Surface Ships  5.3 MARPOL  5.4 IALA Near Miss Reporting  5.5. New 857 (20)  5.5.1 Provision of Information  5.5.2 Management of Ship traffic  5.5.3 Responding to unsafe situations  **6 Development Project Outcomes**  6.1 Ship Traffic Management (EU)  6.2 EfficienSea II / Maritime Communications Platform (EU / Korea)  **7. Emerging Technologies**  7.1 Connected VTS  7.2 Third Party Services (including cloud based services)  7.3 eNavigation  **8. Impact of VTS Implementation** |

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| --- | --- | --- | --- | --- | --- | --- |
|  | High Level Operational Requirement | Second Level Requirement | Third Level | | Fourth Level | Fifth Level |
| 1 | Marine Autonomous Surface Ships (MASS) | Shore based Ship Control |  | |  |  |
| Fully Autonomous | Pilotage |  | |  |
| Navigational Assistance |  | |  |
| 2 | IMO Greenhouse Gas Strategy | Reduce Emissions from Ships by 50% by 2050 |  | |  |  |
| Establish Just in Time Arrivals | VTS beyond Territorial Seas | |  |  |
| Coastal VTS | | Maritime Safety | Aids to Navigation |
| Maritime Security | Anti-Smuggling |
| Anti-Piracy |
| AI based Decision Support Tools | | Route Exchange | Connected VTS Systems |
| Route Updates (from Ships) |
| Environmental Ship Index |  | |  |  |
| 3 | Safety of Navigation | Situation Awareness |  | |  |  |
|  |  | |  |  |
| 4 | Protection of the Marine Environment |  |  | |  |  |
| 5 | Near Miss Reporting | Digital Situation Awareness | Heat Maps | |  |  |
| Search & Rescue |  | |  |  |

< a snapshot of each development in a summary table such as>

| **Emerging trend / technology / practice** | **Link to the structure adopted** | **Potential Impact/s on VTS**  (L, M, H) | **Expected Timeframe** | **Committee Action / Response** |
| --- | --- | --- | --- | --- |
| Advanced Decision Support Services |  |  |  |  |
| Digital technologies and communications |  |  |  |  |
| Automated Data and Information Exchange |  |  |  |  |
| Maritime Autonomous Surface Ships |  |  |  |  |
| Navigational Assistance |  |  |  |  |
| Coastal / Regional VTS |  |  |  |  |
| Beyond territorial seas |  |  |  |  |
| Marine Spatial Planning |  |  |  |  |
| Green House Gas Polices |  |  |  |  |
| Interacting Objects |  |  |  |  |
| Digital situational awareness / Common Situational awareness |  |  |  |  |
| Just in Time / Slot Management |  |  |  |  |
| Role of VTS |  |  |  |  |

# GUIDING PRINCIPLES

The following guiding principles have been adopted to assist the Committee identify, assess and monitor emerging trends, technologies, practices and developments and strategically plan and coordinate embracing these changes for VTS to improve the safety and efficiency of navigation, contribute to the safety of life at sea and support protection of the marine environment.

1. The document should concisely describe:

* The emerging practice, technology or trend.
* The significance of the emerging practice, technology or trend for VTS and why it should be monitored / assessed by the Committee.

This should include references to entities associated with the emerging developments and recognised publications/documents.

* The anticipated impact/s, highlighting whether these relate to, for example:
* The legal and regulatory framework for VTS.
* IALA Standards.
* International instruments outside the VTS domain.
* The timeframe expected for the emerging development to significantly impact.
* The possible challenges it is expected to present for VTS.
* The opportunities for VTS that may be realised in actively embracing the changes the practice / technology.

1. The document should not provide detailed or lengthy discussion on each development. Its focus should be on providing a high-level reference as described in Paragraph 1 above. Detailed information and discussion should be contained in associated Work Programme task/s adopted to embrace/respond to developments.

# DISCUSSION

## Expectations for ‘Future VTS’

<Suggest Section should aim to describe, in a concise and high level way, a ‘common view’ of what future VTS may look like with regards to capabilities and purpose>

According to IMO Resolution A.857 (20) Vessel Traffic Services are implemented to improve the safety and efficiency of vessel traffic and to protect the marine environment. The service should have the capability to interact with the traffic and to respond to traffic situations developing in the area. With the recognition of IALA “as an important contributor to IMO's role and responsibilities relating to vessel traffic”, the three defined purposes for VTS (provision of information, monitoring and management of ship traffic and responding to developing unsafe situations) and the explicit possibilities for data exchange and automated reporting, the revised IMO resolution A.857(20) does give direction towards the future of VTS.

***Introducing digital maritime aids to navigation services***

As mentioned by IMO the service should have the capability to interact with the traffic and to respond to traffic situations. Vessels will be more and more capable and making use of digital interact by exchanging specific information about the intentions, characteristics, limitations, environment and the ships master will use that information for faster and more accurate decisions support. Introducing digital maritime aids to navigation services by VTS authorities should encourage data exchange and enhance safety and efficiency.

Standardization for (automated) digital maritime services will make it possible to increase safety within VTS areas by reducing the amount of spoken information on standard situations and thereby common misunderstandings between ships and VTS authorities, structuring and enlarging the amount of information exchange with use of digital standards and allowing VTS authorities to have more focus on management by exception by detecting and responding to developing unsafe situations.

Future VTS will be more about ensuring that vessels have a secured and proper information position by enabling digital information exchange and automated interaction, monitoring and managing traffic for safe and efficient ship movements and advanced detection systems for developing unsafe situations. Broadly speaking, three themes can be discussed: Digital situational awareness, Interacting objects and Advanced decision support.

***Object detection and visibility for full digital situational awareness:*** *Using other eyes to support and validate your own point of view*

Within the world of shipping the use of multiple sensors are already common technology. Radar and AIS for example are already fully integrated within ECDIS and VTS systems. Full visibility with 100% object detection on all weather conditions however has not been seen yet. In the last years there where many initiatives to add new types of sensors and Artificial Intelligent services to ship bridge systems. All to achieve a better object visibility and support the ships commander.

The digitization of society has the advantage that certain decision-making can be made faster and better. The more we rely on the support tools however, the more we need to ensure that the input from these tools is reliable and complete. Highly automated bridges, shore control centers and VTS services providers, with digital decision support services, will need full digital situational awareness in the future to provide the best services

It is however very likely that 100% digital situational awareness will not be achieved with just the sensors set of one single (on board) systems, or in any case not with an affordable business case. Using sensors from other objects and shore based systems might be one of the possibility’s to create a full object visibility. Lots of technical and standardization issues will appear exploring the use of other objects data, this to explore with inter committee / organization tasks groups.

***Digital maritime aids to navigation services and interacting objects:*** *Silent VTS will be all about specific, faster and more accurate communication.*

Emerging technologies radically transform the ways in which we behave and interact with each other. Within the technical possibilities moreover objects are communicating with each other and sharing information to support their users for a safe, smart and smooth experience. Bridges for example are able to tell cars that they will open soon and the route information system within the car will adjust the advised route. Autonomous and highly digitized ships (smart ships) will and must be able to interact with each other and with shore support systems like VTS. Connecting digital ships and the digital shore systems will be about interacting objects. “Silent” Digital Maritime Aids to Navigation services will provide specific, faster and more accurate information exchange.

It requires technology and standardization to create an ecosystem where objects are able to interact with each other. Intelligence will be add to the ecosystem. Objects don't necessarily communicate with each other by passing only messages. They communicate with each other in a way that allows them to specify what they want, but leaves the implementation of that behavior to the receiving object. So interaction between ships will be, next to standardization, about interpretation and predictable behavior. One of the main questions to be answered is “Do I understand the information I receive and do we have a common view on each other’s near future behavior.” How do we make sure that objects will make the best decision. Because at the end someone somewhere will be responsibility for its objects behavior.

***Advanced decision support:***

Decision Support Tools (DST) are used for enhance situation awareness and to make better decisions in routine or non-routine situations. It is especially useful facing decisions about developing situations or emergency situations. These tools should assist decision making activities at strategic, tactical and operational levels. In order to assist ships a specific context, some DST may require user input such as the vessel(s) concerned or the area supervised. In other cases, some tools are working permanently in a self-contained way and should inform the ships and VTS personnel automatically. Whatever type of DST is used, the final decision is always at the discretion of the decision-maker according to the relevant operational procedures. The use of DST may differ depending on the user, activity, needs and services. The reviewed guideline G1110 classifies DST’s as alerting, advisory, or cooperative.

***The changing role of VTS****: A new role on the horizon: Validating, safeguarding and managing the digital information position of ships in your area.*

The further information will be shared digital and automatically the more the role of VTS will change. Within cooperative DST for example the participant has been part of the decision and will already be aware of the context information and will not be needed to be informed by traditional communication, the VTS-operator will lose their “informing” task to a greater or lesser extent.

VTS operators provide information to improve the safety within the area for all ships, as well conventional and digital. The objective, improving the safety, does not change by implementing digital services. In fact, it should promote this by specific, faster and more accurate communication. There will be a shift from informing towards confirming that participants understood the information as received and whether the information corresponds to what where available. Validating, safeguarding and managing the digital information position of ships in the area.

That is:

* Digital situational awareness
* Interacting objects
* advanced decision support.

## Emerging practices, technologies and trends

The Committee has identified the following practices and emerging technologies as potentially having a direct impact on VTS in the near to medium term:

* Advanced Decision Support Services
* Digital technologies and communications
* Automated Data and Information Exchange
* Maritime Autonomous Surface Ships
* Navigational Assistance
* Coastal / Regional VTS
* Beyond territorial seas
* Marine Spatial Planning
* Green House Gas Polices
* Interacting Objects
* Digital situational awareness / Common Situational awareness
* Just in Time / Slot Management
* Role of VTS
* New sensing technology for nearshore and port waters
* Long-distance sensing technology

### Advanced Decision Support Services

Decision Support Tools (DST) are used for enhance situation awareness and to make better decisions in routine or non-routine situations. It is especially useful facing decisions about developing situations or emergency situations. These tools should assist decision making activities at strategic, tactical and operational levels.

According to IMO Resolution A.857 Vessel Traffic Services are implemented to improve the safety and efficiency of vessel traffic and to protect the marine environment. The service should have the capability to interact with the traffic and to respond to traffic situations developing in the area. In order to assist ships a specific context, some DST may require user input such as the vessel(s) concerned or the area supervised. In other cases, some tools are working permanently in a self-contained way and should interact between and inform the ships and VTS personnel automatically.

The advent of advanced decision support services will significantly affect how VTS has ‘traditionally’ been provided. In particular, it will enable VTS to be more proactive in managing ship traffic and providing an information hub enabling information exchange and automated interaction.

Transitioning to advanced decision support services will have an impact on VTS providers, including:

* Having appropriate equipment, systems and facilities in place, (including use of artificial intelligence technology); and
* Ensuring VTS personnel are appropriately trained:
  + In advanced decision support services and responding the ‘decisions’ it provides
  + Responding to automated data and information exchange.
  + Operating in an environment with automated interaction and communications
* Managing a changing role for VTS personnel, with a greater focus on the management of ship traffic. (including Just in Time)

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| **Key References:** | <to follow> |
| **Potential Impact/s:** | IALA standards relating to VTS will need to be revised/updated and new documentation may be required to ensure the harmonised delivery of VTS worldwide. Key areas include, for example:   * Operational procedures * VTS interaction and Communications * Training for VTS personnel * Standards for advanced decision support services * Data validation and management |
| **Expected Timeframe:** | <to follow> |
| **Challenges:** | <to follow> |
| **Opportunities:** | Advanced decision support services and more automated data and information exchange offers many benefits for VTS to proactively contribute to the safety and efficiency of navigation and protection of the environment. |
| **Committee Action / Response in place:** | To strategically plan for the changes associated with advanced decision support services through.   * Engaging VTS authorities and technical experts in advanced decision support services * Assessing the emerging changes and likely impact/s * Preparing revised / new IALA guidance |

<Additional text provided by China MSA>

| **Item** | **Guiding Principle** |
| --- | --- |
| **Title** | The VTS Decision Support Tool based on Artificial Intelligence. |
| **Introduction:** | On the basis of demand analysis, model establishment, etc, China Maritime Safety Administration completed the research and development of AI-based autonomous detection system for ships’ abnormal behaviours in 2018, and put it into use as a VTS decision support tool in some VTS centres. The system improves the accuracy of identifying and predicting vessel’s unsafe behaviours in the VTS area, and provides intelligent decision support for VTS personnel to respond in time and intervene in possible accident risks in advance. |
| **Key References:** | Input Paper VTS49-8.2.8 The Application of a VTS Decision Support Tool based on Artificial Intelligence |
| **Potential Impact/s:** | With the development of the DST based on AI, the future VTS will further improve the safety and efficiency of vessel traffic and protect the marine environment. These IALA documents will be needed to review and update, such as:   * IALA Guideline 1110 - Use of Decision Support Tools for VTS Personnel * Guideline 1045 on staffing level at VTS centres. * Documents for Training and Certification of VTS Personnel and its associated Model Courses. |
| **Expected Timeframe:** | Already in use in some China’s VTS centres |
| **Challenges:** | * update the present VTS system;. * VTS personnel training |
| **Opportunities:** | * more smart for decision making * more safety and efficiency of vessel traffic |
| **Committee Action / Response in place:** | * ongoing monitoring the use of the new DST based on AI * Liaison/engagement with other IALA Committees and external bodies. |

### Digital technologies and communications

The core of future VTS is the deep development and application of maritime traffic and environment data. In recent years, the public communication network has developed rapidly, and the effective coverage of the shore-based mobile phone base station has been continuously expanding, basically covering the nearshore waters and port areas. The public communication network has the advantages of high communication rate, stable data transmission and low communication cost. At the same time, with the development of technology and the increase of users, the satellite communication has its bandwidth been significantly improved, while its cost greatly reduced. The development of public communication network makes its offshore application possible.

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| **Key References:** | Develop a Guideline on Maritime Services in the context of E-Navigation relating to VTS（VTS50 task 1.2.4）  Develop a Recommendation on Digital information transfer between ship and shore in VTS operations（VTS50 task 1.3.2） |
| **Potential Impact/s:** | Along with in-depth study of E-Navigation strategy, there will be significant changes in digital technologies and communication, the new requirements for ship-shore data interaction will have a profound impact on the future VTS, including IALA Documents, equipments, personnel, etc.  First, these IALA documents will be needed to review and update, such as:   * IALA Guideline 1132 – VTS VHF Voice Communication * IALA Guideline 1111 – Preparation of Operational and Technical Performance Requirements for VTS Systems * IALA Recommendation 0145 – The iner-VTS Exchange Format (IVEF) Service.   Second, with the progress of technology, the equipment of ship-shore/ship-ship data interaction will face updating iteration.  Thirdly, VTS operators need further training in their operational skills, including theoretical knowledge, operating procedures, and communication standards.  Especially, it will promote S-100 electronic chart application. |
| **Expected Timeframe:** | In recent 5-10 years |
| **Challenges:** | * update the present IALA Documents; * update the present VTS equipments;. * VTS personnel training. |
| **Opportunities:** | * more lager communication capacity; * more intelligent of vessel traffic service; * more safety and efficiency of vessel traffic. |
| **Committee Action / Response in place:** | * consider fusion communication mode in the process of developing an adaptation document for future VTS * Liaison/engagement with other IALA Committees and external bodies. |

### Automated Data and Information Exchange

The S-100 Standard is a framework document that is intended for the development of digital products and services for hydrographic, maritime and GIS communities. It comprises multiple parts that are based on the geospatial standards developed by the International Organization for Standardization, Technical Committee 211 (ISO/TC211).

VTS Digital Information Service Product Specification（S-212）is based on the IHO S-100 framework specification and the ISO 19100 series of standards，which describe the Navigational situation(including traffic and route information), Navigational warning, Meteorology, Meteorology warning, Hydrography, Electronic navigational aids, Other information(Port Information, Cargo Information and so on), VTS or ships provide information with fixed time and time difference when requested.

E-NAVIGATION and MS：When developing the IMO e-Navigation strategy to improve safety and efficiency of sea transport it became clear that digital services provided to ships are an essential part of this initiative. In order to best describe, structure and implement those services, the IMO introduced the concept of “Marine Service Portfolios” (MSPs). ‘A “Maritime Service Portfolio (MSP)” that define and describe the set of operational and technical services and their level of service provided by a stakeholder in a given area, navigable waterway or port, as appropriate. The IMO has identified a preliminary list of 16 MSPs. Under its remit, IALA has recognised that additional MSPs are were needed for items such as AtoNs and PNT.

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| --- | --- |
| **Key References:** | **IHO S-100:** *IHO Universal Hydrographic Data Model, Edition 4.0.0 (December 2018);*  **IMO MSC.1/****Circ.1610:***Initial Descriptions of Maritime Services in the Context of E-navigation(14 June 2019);* |
| **Potential Impact/s:** | These IALA documents will be needed to review and update, such as:   * Guideline on the portrayal of VTS information and data * Operational and Technical Performance Requirements for VTS Systems * V-103 Standards for Training and Certification of VTS Personnel * V-125 The use and presentation of symbology at a VTS Centre * V-128 Operational and Technical Performance of VTS Systems * Recommendation V-145 on the Inter-VTS Exchange Format (IVEF) Service * VTS50-10.3.1 WP VTS Digital Information Service product specification V0.6.3 (VTS49-12.2.2.4) * VTS50-9.2.4 WP Draft Guideline on Maritime Services (VTS49-12.2.1.5 ) |
| **Expected Timeframe:** | In recent 5-10 years |
| **Challenges:** | * Update the present VTS system; * VTS personnel training |
| **Opportunities:** | * With the development of integrated communication technology and the decline of satellite communication fees, the cost of ship-to-shore data interaction continues to decrease, and the integration and mining of large-scale digital information becomes possible, which will further fulfill the identification of risk, management of traffic flow and allocation of navigation resource in VTS area based on big data. * Under the background of digitalization, VTS will become the information, coordination and supervision center of smart port; meanwhile, its function will transit from service to supervision. |
| **Committee Action / Response in place:** | * Ongoing monitoring. * Preparation of revised / new IALA documents. * Liaison/engagement with other IALA Committees and external bodies. |

### Maritime Autonomous Surface Ships

Being aware that vessel traffic services are provided worldwide and make a valuable contribution to safety of navigation, improved traffic efficiency and the protection of the marine environment. Recognizing that close cooperation between vessel traffic service personnel and participating vessels determines the level of safety and efficiency of maritime traffic in the areas covered by vessel traffic service.

The rapid development of Maritime Autonomous Surface Ship (hereinafter referred to as MASS) has a profound impact on the entire shipping industry, which also brought new challenges to this “close cooperation” between VTS personnel and participated vessels. How VTS will provide service for MASS in the future requires our serious consideration.

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| --- | --- |
| **Key References:** | China MSA. (2020). Scoping exercise on the implications of MASS on VTS documents (VTS48-8-2.6).  NL Paper on the impact of MASS on VTS (VTS49-3.1.2).  Impact of MASS on Marine Aids to Navigation: PAP41-6.1.5.1 |
| **Potential Impact/s:** | These IALA documents will be needed to considered, such as:   * Interaction between VTS, MASS and conventional ships, * Qualification of VTS personnel * International and local rules and regulations such as COLEREG1972, and TSS; * VTS50-10.3.1 WP VTS Digital Information Service product specification V0.6.3 (VTS49-12.2.2.4) |
| **Expected Timeframe:** | In recent 5-20 years |
| **Challenges:** | * Uncertainty of development of MASS * Complication of MASS technology |
| **Opportunities:** | * Digitalization of VTS would be fulfilled with the MASS technology come true, which will bring a huge challenge to the VTS working procedures. * Under the background of digitalization, VTS will become the information, coordination and supervision center of smart port; meanwhile, its function will transit from service to supervision. * DST would be used in the future VTS |
| **Committee Action / Response in place:** | * Considering the output of inter-Committee task (MASS task group). * Considering the output of TG 1.2.5 |

### Navigational Assistance

<to follow>

### Coastal / Regional VTS

<to follow>

### Beyond territorial seas

<to follow>

### Marine Spatial Planning

<to follow>

### Green House Gas Polices Maritime

<to follow>

### Interacting Objects

<to follow>

### Digital situational awareness / Common Situational awareness

<to follow>

### Just in Time / Slot Management

The concept of JIT Arrival of ships allows for ships to optimize their speed during the voyage in order to arrive at the Pilot Boarding Place when the availability of berth, fairway and nautical services is ensured. In other words, ships do not have to “wait” outside the port at anchorages for many hours, days or even weeks, or manoeuvre at very low speeds in the port area while waiting for the availability of berth, fairway and nautical services. This results in reducing the fuel consumption and Green House Gas emissions from ships, supporting the low carbon shipping.

The development of JIT Arrival Guide is to provide information and proposals to the port and shipping sectors as well as port and maritime administrations on how to facilitate JIT Arrival of ships – with a view to reducing Green House Gas emissions by optimizing the port call business process and providing sustainable solutions to customers in the end-to-end supply chain.

A brief of the affects the concept of JIT Arrival may bring to the VTS, such as:

* The VTS personnel training relating to the data analysis
* The updating of equipment concerning coverage area the radar

|  |  |
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| **Key References:** | JIT Arrival, Real Time Date Sharing, Environmental Protection |
| **Potential Impact/s:** | The adoption of JIT Arrival is of great benefits including Lower GHG emissions and reduced air pollution, enhanced supply chain visibility, improved rest hour planning, optimized port processes and better capacity planning of berths, but it also brings some disadvantages such as more workload to provide updates and less opportunities for seafarers for shore leave. Therefore, many regulations and standards remain to be amended for adoption of JIT Arrival including Maritime Labour Convention, training of seafarer, technology research and development, etc. |
| **Expected Timeframe:** | A new Just In Time Arrival Guide which aims to provide both port and shipping sectors with practical guidance on how to facilitate Just In Time Arrivals has been released in 2020. |
| **Challenges:** | 1. Technological limitation. VHF has a range of approximately 30 Nm which is too short a distance for ships to optimize speed and take full advantage of JIT Arrival potential to arrive at port when the berth and all required services are available.  2. Real time data sharing. The VTS has the difficult in acquiring the real time data for Just In Time Arrivals. This results in hesitation to allow |
| **Opportunities:** | The adoption of JIT Arrival allows the VTS to take the maritime safety administration to a new and higher level, such as the improved anchorage management, the navigation order of ships, the enhanced ability to pollution prevention and response,etc. |
| **Committee Action / Response in place:** | The Committees are invited to take actions such as:   * Ongoing monitoring. * Preparation of the guiding documents for the development of JIT Arrival Guide * Liaison/engagement with other IALA Committees and external bodies. |

### Role of VTS

<to follow>

### New sensing technology for nearshore and port waters

Concerning the VTS monitoring in nearshore and port waters, there is a limitation that should not be neglected. This results in having to judge the sailing state of the ship through the dynamic image of the plane. With the development of technology, high-range CCTV and UAV technology can make up for the deficiency of VTS. With the deployment of high-range CCTV cameras in the high points of nearshore and port waters, a 360-degree monitoring within 8 nautical miles can be realized. If appropriate locations are selected, full-coverage monitoring of larger waters can be realized. In addition, the UAV technology can also be used to strengthen the monitoring of VTS. The UAV regularly cruises at fixed points, and then carries out point-to-point signal transmission through remote transmission technology, which can facilitate the effective monitoring of ships’ dynamic movement.

* It can effectively strengthen the water VTS monitoring;
* It can improve the efficiency and ability of VTS to obtain information and provide information services;
* It can improve the early warning ability of VTS;
* The anti-pollution monitoring of ships in water area can be strengthened

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| **Key References:** |  |
| **Potential Impact/s:** | * The legal and regulatory framework for VTS. * IALA Standards.. |
| **Expected Timeframe:** | In 2021-2025 |
| **Challenges:** | * Comprehensive coverage of the communication network * Network security * Deployment point location selection * Loss of fixed assets |
| **Opportunities:** | * Three-dimensional integrated monitoring * Smarter decision making * More intuitive regulation |
| **Committee Action / Response in place:** | * Ongoing monitoring. |

### Long-distance sensing technology

* The next generation of ship identification and tracking system for future VTS should have considerably larger coverage and capacity compared with the current system.
* Satellite-based AIS, LRIT (Long Range Identification and Tracking System) ,and Internet-based AIS are drawing much attention from the academia and the industry;
* Satellite-based AIS can integrate all the static and dynamic information of the ships all over the world. It can significantly expand the coverage and capacity of the current AIS system.
* The LRIT is an automatic data exchange system that broadcast ship-related information (name, MMSI, position, date and time, etc.) every 6 hours without human interference or different time intervals to the LRIT data center. It can extremely expand the coverage of the current ship identification and tracking system and is compatible with the AIS system.
* The Internet-based AIS can collect ship dynamic and static information from ships without equipment of AIS via mobile communication station or satellite communication station.
* Current VTS mainly utilize traditional AIS and Radar as the data sources to collect information about ships’ dynamic and static information. Due to the limitation of the signal coverage, the current system can only be applied in port areas or inland waterways, while the ships navigating beyond the territorial seas are difficult to identify and monitor, which leaves risk to the maritime transportation system. These new technologies can facilitate the current VTS to obtain information with much larger coverage and higher data compacity to improve the situation awareness of the VTS.

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| **Key References:** | Resolution MSC.202(81)  Resolution MSC.263(84)  R0124-19 Satellite AIS considerations (A-124 App.19) |
| **Potential Impact/s:** | * The technological framework and facilities of the current VTS system could be revised with the introduction of new systems. * IALA Standards for ship identification and tracking system. * Legal framework and regulations for the IALA and IMO participants as new law or regulations may be necessary for such an improvement. |
| **Expected Timeframe:** | Satellite-based AIS and LRIT is already in use，Internet-based AIS is under developing. |
| **Challenges:** | * Compatibility between the current VTS system and Internet-based and satellite-based AIS system. * Coverage of the public mobile communication network in port areas. * Coverage and capacity of satellite for maritime data communications. * Equipment installing and upgrade on merchant ships. * Cyber security. |
| **Opportunities:** | * Highly accurate situation awareness of the maritime transport in the surveillance area. * Large coverage and capacity for better services to ships, etc. * Strong facilitate for maritime search and rescue operation for sea areas afar. |
| **Committee Action / Response in place:** | * Ongoing monitoring. * Scoping/preparing a new Work programme task. * Preparation of revised / new IALA documents. * Liaison/engagement with other IALA Committees and external bodies. |

# DEFINITIONS

The definitions of terms used in this document can be found in the International Dictionary of Marine Aids to Navigation (IALA Dictionary) at <http://www.iala-aism.org/wiki/dictionary> and were checked as correct at the time of going to print.

Where conflict arises, the IALA Dictionary should be considered as the authoritative source of definitions used in IALA documents.

# ACRONYMS

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