

IALA GUIDELINE

1117

VHF DATA EXCHANGE SYSTEM (VDES) OVERVIEW

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DOCUMENT REVISION

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1. INTRODUCTION

1.1. PURPOSE OF THE DOCUMENT

This Guideline provides an introduction to the VHF Data Exchange System (VDES) at an overview level. It does not include technical details.

This document is intended to assist in the understanding, development and promotion of VDES.

1.2. BACKGROUND

AIS is well recognized and accepted as an important tool for safety of navigation and is a carriage requirement for SOLAS vessels (Class-A). With increasing demand for maritime VHF data communications, AIS has become heavily used for maritime safety, maritime situational awareness and port security. As a result, overloading of AIS 1 and AIS 2 created a need for additional AIS channels.

International Telecommunications Union (ITU) has recognised the efficiency and the necessity for digital communications, has produced technical standards and has revised the VHF marine band (RR Appendix 18) to designate channels for data transmission. It is recognized that both analogue voice communications and digital communications will share the band. The VDES, as envisioned by IALA and presented to ITU, addresses the identified need to protect AIS along with essential digital communications contributions for e-Navigation and GMDSS Modernization.

The VHF marine band (Appendix 18 of the International Radio Regulations) was initially used for transmission of voice communications on 25 kHz channels. The ITU introduced the first marine data transmission system, DSC (Digital Selective Calling)¹ to help ensure that calling and distress communications attempts were successful. VHF DSC transmits data at 1.2 kbps, slow by modern data standards, but very robust. At the request of the IMO to improve safety of navigation, ITU introduced another VHF data transmission system, AIS², which provides navigation and identification data for ships, shore stations, aids to navigation and search and rescue devices at 9.6 kbps.

ITU introduced a standard³, with options for 25 kHz, 50 kHz and 100 kHz channels at data rates up to 307.2 kbps in order to improve spectrum efficiency in 2012. Both voice and data communications coexist in the VHF marine band.

Consequential to WRC-15, the ITU standard for VDES, Recommendation ITU-R M.2092-0, was approved. A remaining outstanding issue is the approval of the satellite component for the VDE channels which is targeted for approval at WRC-19.

1 Recommendation ITU-R M.493

2 Recommendation ITU-R M.1371

3 Recommendation ITU-R M.1842

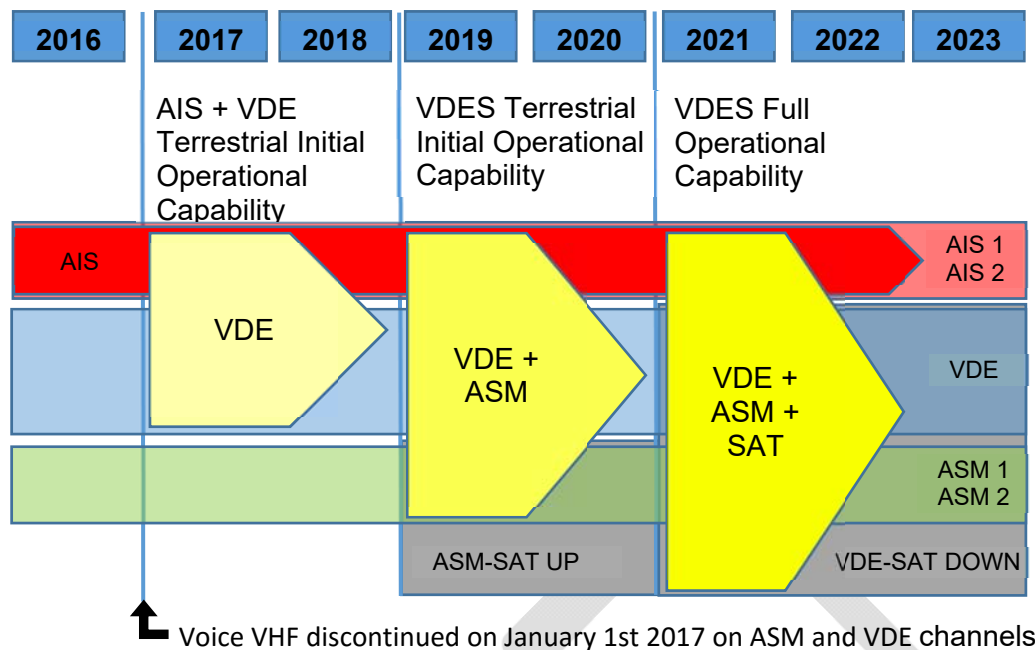


Figure 1 Implementation of VDES

The introduction of VDES is expected to happen through four operational phases:

- 1 (2016) AIS exists as defined by ITU.R M.1371-5 on the AIS frequencies, and Coastal Stations use the ASM and VDE frequencies for Voice VHF.
- 2 (2017-2018) Post WRC15 - AIS+ASM: Regionally, where there is an urgent need for offloading the AIS VDL from significant ASM traffic, it is recommended to allow the introduction of 4-channel AIS + ASM devices. These devices may receive and transmit ASM on the ASM1 and ASM2 frequencies, but shall discontinue their transmit capability, using the existing GMSK modulation after January 1st 2019 unless a software upgrade enables them to participate in the modulation and access scheme agreed for the ASM frequencies. Note that the ASM frequencies will need to be shared with the VHF voice service from Coast Stations in many areas during this time frame.
- 3 (2019-2020) It is foreseen that when the VDES is finalized, initial operational capability can be established after January 1st 2019, replacing any GMSK modulation on the ASM1 and ASM2 frequencies, and introducing terrestrial VDE. Note that both the ASM and VDE frequencies will still need to be shared with the voice VHF service in many areas.
- 4 (2021+) When a satellite service is developed, full operational capability of the VDES including the Satellite frequencies can be achieved.

1.3. OVERVIEW

The VHF Data Exchange System (VDES) is seen as an effective and efficient use of radio spectrum, building on the capabilities of AIS and addressing the increasing requirements for data through the system. New techniques providing higher data rates than those used for AIS is a core element of VDES. Furthermore, VDES network protocol is optimized for data communication so that each VDES message is transmitted with a high confidence of reception.

In this document, when communications from ship to shore are referenced, this includes ship to satellite to shore and shore to satellite to ship. It is noted that, following WRC-15, the full satellite capability of VDES is still under development and will be reviewed at WRC-19.

2. GENERAL DESCRIPTION

The VDES should improve the safety of life at sea, the safety and efficiency of navigation, and the protection of marine environment and enhance maritime safety and security. These goals will be achieved through efficient and effective use of maritime radiocommunications, incorporating the following functional requirements:

- 1 As a means of AIS.
- 2 As a means of radiocommunications equipment through exchange of digital data between ship and ship, ship and shore including satellite via AIS, Application Specific Messages (ASM) and VHF Data Exchange (VDE).
- 3 As a means of applications external to the VDES equipment itself. These applications use AIS, ASM or VDE separately or combined.

2.1. SYSTEM CONCEPT

The VDES concept was originally proposed to address emerging indications of overload of the VHF Data Link (VDL) of AIS and simultaneously enable a wider seamless data exchange for e-navigation, potentially supporting the modernization of GMDSS. In addition, VDES could support the increasing communications requirements identified through the development of e-Navigation, as documented in the e-Navigation Strategic Implementation Plan (SIP).

The purpose of e-navigation is to enhance berth-to-berth navigation and related services for safety and security at sea and protection of the marine environment. e-navigation seeks to enhance maritime safety through simplification and harmonization of information. In addition, e-navigation seeks to facilitate and increase efficiency of maritime trade and transport by improved information exchange.

The VDES system concept recognises the parallel work being carried out related to e-navigation maritime service portfolios (MSP). Where applicable, these MSP are referenced in this user requirements document.

Table 1 identifies the e-navigation maritime service portfolios (MSP) as defined by IMO e-navigation strategic implementation plan (SIP) (NCSR1/28/Annex 7).

Table 1 *Maritime Service Portfolio, IMO e-navigation Strategic Implementation Plan*

| MSP reference | Service |
|---------------|--|
| MSP 1 | VTIS Information Service (IS); |
| MSP 2 | VTIS Navigation Assistance Service (NAS) |
| MSP 3 | VTIS Traffic Organization Service (TOS) |
| MSP 4 | Local Port Service (LPS) |
| MSP 5 | Maritime Safety Information (MSI) service |
| MSP 6 | pilotage service |
| MSP 7 | tugs service |
| MSP 8 | vessel shore reporting |
| MSP 9 | Telemedical Maritime Assistance Service (TMAS) |
| MSP 10 | Maritime Assistance Service (MAS) |
| MSP 11 | nautical chart service |
| MSP 12 | nautical publications service |
| MSP 13 | ice navigation service |
| MSP 14 | Meteorological information service |

| MSP reference | Service |
|---------------|---|
| MSP 15 | real-time hydrographic and environmental information services |
| MSP 16 | Search and Rescue (SAR) Service |

The system concept, including VDES functions and frequency usage are illustrated pictorially in Figure 2 (full system)

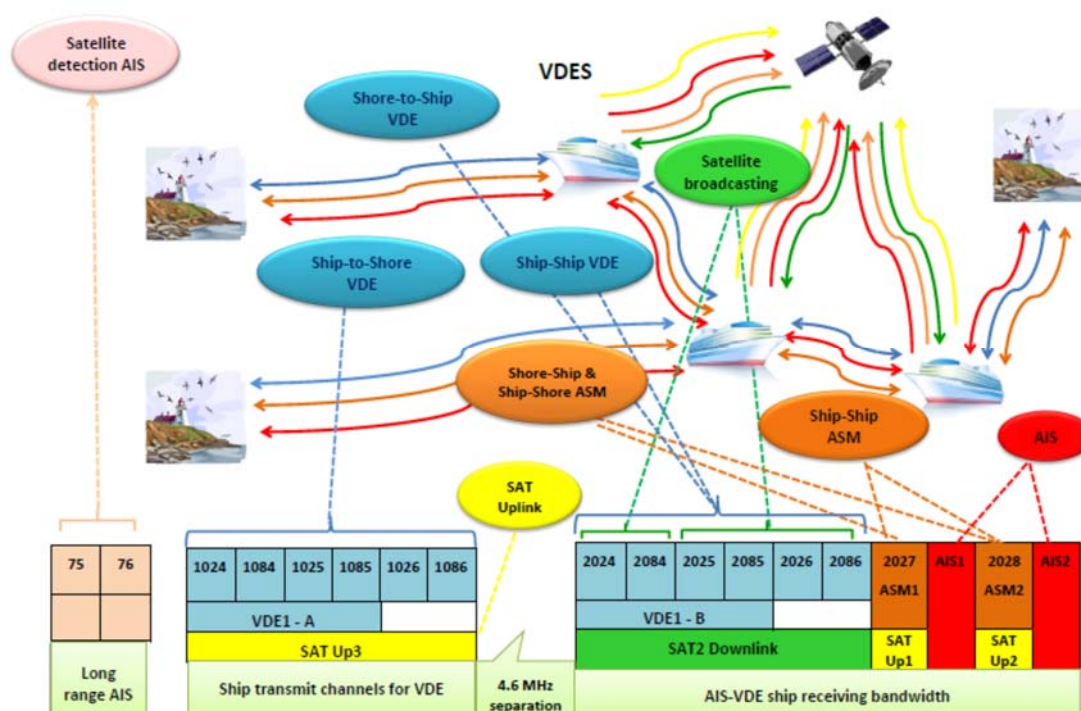


Figure 2 *VDES functions and frequency use – full system*

2.2. CONCEPT OF OPERATIONS

The key concept of operation of the VDES includes:

- 1 The VDES provides a capability of data exchange between ships and shore users by terrestrial or satellite link.
- 2 Data exchange from the ship may occur automatically or manually.
- 3 Data exchange uses the designated VHF channel(s).
- 4 Transmission and reception of the data occurs with the minimum involvement of ship's personnel.
- 5 The VDES includes existing AIS applications.
- 6 The VDES includes existing ASM.
- 7 VDES additional capabilities include support of the VHF Data Exchange (VDE).
- 8 The VDES related applications should support language independent communications (e.g. through the use of a digital data dictionaries).
- 9 The VDES implements data integrity monitoring at the VDES link level (e.g. check sum).
- 10 The VDES related applications address cyber security (e.g. authentication, key management and, if required, encryption).

- 11 The VDES has a high level of availability.
- 12 The VDES supports machine-to-machine communications (for example, interfaces with external equipment providing applications related to VDES).
- 13 The VDES related applications enable clear comprehension of the information sent / received through the VDES.

The concept of operations is identified in [Figure 3]

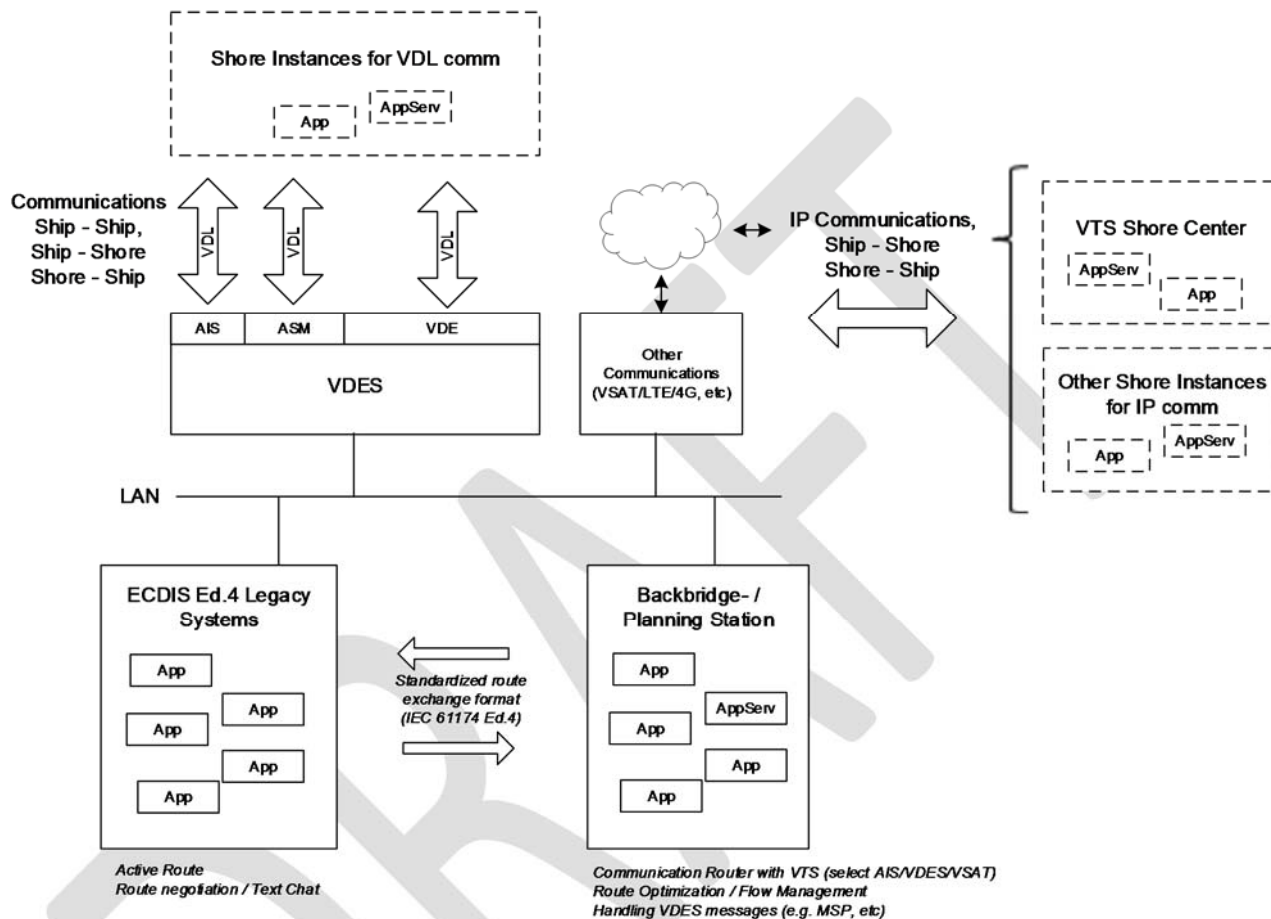


Figure 3 Concept for VDES

2.3. GENERAL

The VDES operates according to ITU-R M.2092, which includes the following operational characteristics:

- 1 The system gives its highest priority to the automatic identification system (AIS) position reporting and safety related information.
- 2 The system installation is capable of receiving and processing the digital messages and interrogating calls.
- 3 The system installation operates continuously while under way, moored or at anchor.
- 4 The system, for the terrestrial links, uses the appropriate time-division multiple access (TDMA) techniques, access schemes and data transmission methods in a synchronized manner.
- 5 The system is capable of various modes of operation, including the autonomous, assigned and polled modes.
- 6 The system prioritizes applications and adapts parameters of the transmission (robustness or capacity) while minimizing system complexity.

2.4. SYSTEM OVERVIEW

The VDES includes:

- 1 Antenna(s), capable of transmitting and receiving data through terrestrial and satellite link.
- 2 An AIS as set out in resolution MSC.74(69) ANNEX3.
- 3 A multi-function data communication and timing process that is interoperable with AIS, ASM and VDE.
- 4 A multi-function transmitter, capable of operating on the designated AIS, ASM and VDE frequencies.
- 5 Multi-function receivers, capable of operating on the designated AIS, ASM and VDE frequencies.
- 6 A means to automatically input data from other sources.
- 7 A means to automatically output data to other devices.
- 8 A means of ensuring the integrity of the data.
- 9 A means to automatically or manually update the device software as needed.
- 10 Functionality of a built in test equipment (BITE).

2.5. ASSUMPTIONS AND DEPENDENCIES

The applications related to the VDES address the following assumptions and dependencies:

- 1 VDES operates within the existing AIS environment.
- 2 VDES respects and supports requirements for GMDSS communications, including SAR, urgency, and safety related messages.
- 3 VDES applications are uniquely identified.
- 4 The VDES related applications operate in a manner that ensures there is no unnecessary repetition of messaging.

2.6. VDES SERVICES

Deciding to implement a VDES service follows the decision matrix provided in [Figure 4]:

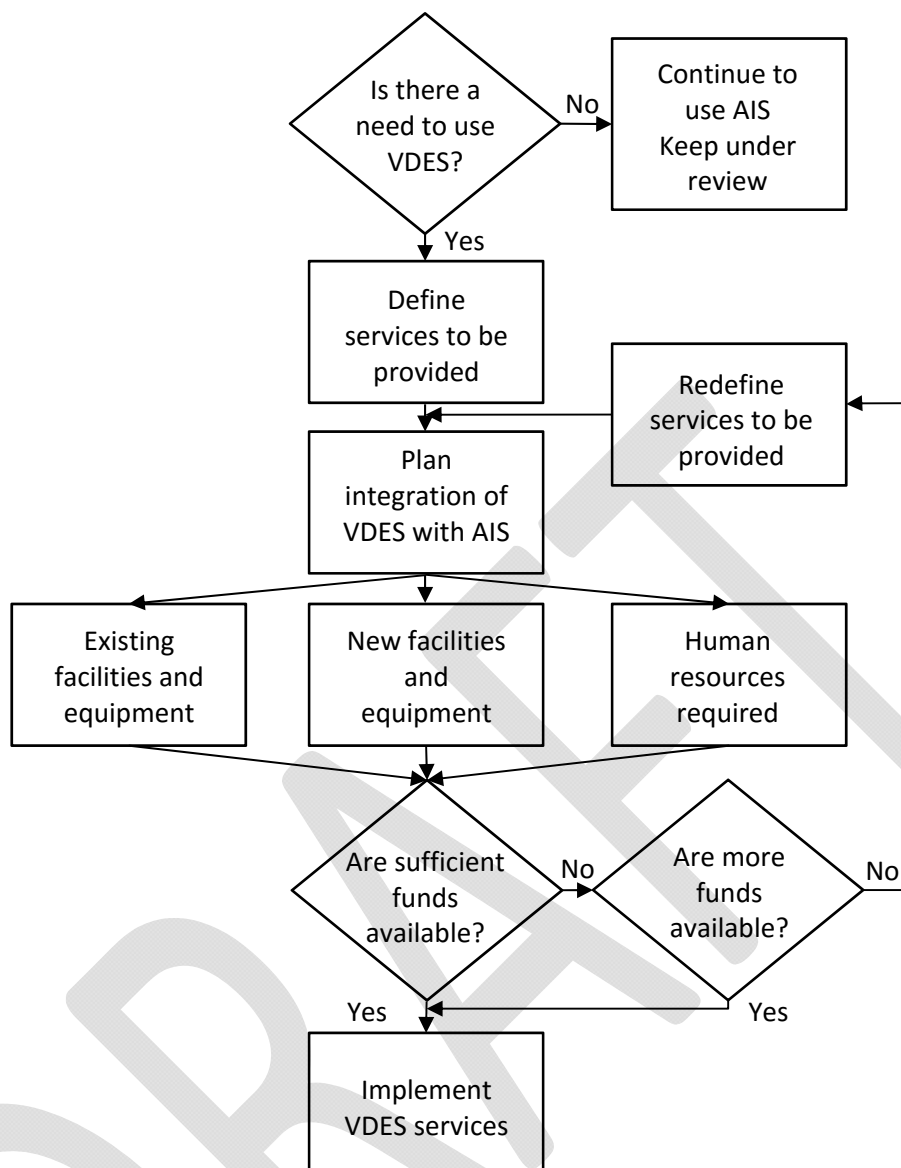


Figure 4 VDES implementation decision matrix

[Table 2] provides further information on considerations for VDES implementation.

Table 2 Considerations for VDES Implementation

| Consideration | Detail | AIS recommended | VDES recommended |
|-------------------------------|---|--------------------------|------------------------------|
| AIS system load | AIS system load (see measurement technique in note 1) | <50% load ⁴ | >50% load |
| Application Specific Messages | Application Specific Messages (ASM) are delayed beyond that acceptable to the users (see note 2) | Service Latency expected | Service Latency not expected |

⁴ More information on VDL loading is available in Report ITU-R M.2287-0

| Consideration | Detail | AIS recommended | VDES recommended |
|---------------------------------|---|-----------------|------------------|
| Advanced data transfer services | If the Advanced system data transfer features are required as per the Maritime Service Portfolios | Not required | Are required |

Note 1: System load is determined by measuring the number of vessels in the coverage area of an AIS base station (a single slot map) and calculating the sum of the slots consumed in the coverage area based on the expected reporting rates of the vessels in the coverage area (Class A, Class B, AtoN and AIS base station) and the number of Addressed Binary Messages (ABM) and Broadcast Binary Messages (BBM) of all types.

Note 2: Service latency is defined as the delivery of the total service from the initiation of the delivery of the service component to the completion of the delivery of that service component e.g. a single maritime chart update.

The services offered by a VDES system will allow for priority with essential services / safety related services having the highest priority and non-essential / commercial service having the lowest priority.

The transfer of data using VDES should consider that the available VDES data transfer capacity is shared by all users within the coverage range of a VDES base station.

3. POTENTIAL USES OF VDES

To assist in identifying possible options for use of VDES a number of potential scenarios have been developed. These are presented to provide context for development and implementation of digital communications, including VDES.

The use cases are cross referenced to Maritime Service Portfolios as noted in Table 3.

Table 3 *Potential VDES Uses cross-referenced to IMO SIP MSP*

| Potential uses of VDES | MSP Reference |
|-----------------------------|--|
| SAR Communications | MSP 9 - Telemedical Maritime Assistance Service (TMAS) MSP 16 - Search and Rescue (SAR) Service |
| Maritime Safety Information | MSP 5 - Maritime Safety Information (MSI) service MSP 13 - Ice navigation service MSP 14 - Meteorological information service MSP 15 - Real-time hydrographic and environmental information services |
| Ship Reporting | MSP 8 - Vessel shore reporting MSP 15 - Real-time hydrographic and environmental information services |
| Vessel Traffic Services | MSP 1 - VTS Information Service (IS) MSP 2 - VTS Navigation Assistance Service (NAS) MSP 3 - VTS Traffic Organization Service (TOS); MSP 4 - Local Port Service (LPS) MSP 6 - Pilotage service MSP 7 - Tugs service |
| Charts and Publications | MSP 11 - Nautical chart service MSP 12 - Nautical publications service MSP 15 - Real-time hydrographic and environmental information services |

| Potential uses of VDES | MSP Reference |
|------------------------|--|
| Route Exchange | MSP 1 - VTS Information Service (IS) MSP 2 - VTS Navigation Assistance Service (NAS) MSP 3 - VTS Traffic Organization Service (TOS); MSP 4 - Local Port Service (LPS) MSP 5 - Maritime Safety Information (MSI) service MSP 6 - Pilotage service MSP 7 - Tugs service MSP 8 - Vessel shore reporting MSP 10 - Maritime Assistance Service (MAS) MSP 11 - Nautical chart service MSP 12 - Nautical publications service MSP 13 - Ice navigation service MSP 14 - Meteorological information service MSP 15 - Real-time hydrographic and environmental information services MSP 16 - Search and Rescue (SAR) Service |
| Logistics | MSP 7 - Tugs service |

3.1. SAR COMMUNICATIONS

SAR Communications are defined in existing documentation (ref SOLAS IV, SAR 79, IAMSAR Manual, NAVTEX manual and SafetyNet manual).

VDES is a technology that supplements AIS communications, and as such may be used for data communication of Maritime Safety Information (MSI) and supplementary distress communications.

When available, the VDES satellite component (VDE-SAT) may be an effective means to extend the VDES to areas outside of coastal VHF coverage. The VDES-SAT may deliver information in a broadcast, multicast or unicast mode to a broad area, addressing many ships using only minimal radio spectrum resources. The VDE-SAT will provide a communication channel that is complementary to GMDSS and the terrestrial components of the VDES system (i.e. coordinated with terrestrial VDES, application specific messages (ASM) and AIS functionalities and their supporting systems).

As a communications medium, VDES may be used to relay distress alerts and locating signals (i.e. SARTs). VDES has also potential to supplement other GMDSS functional requirements which require further development through the GMDSS review process.

In this use case the mix of current communications and developing communications techniques can enhance and improve the sharing of information in prosecution of a SAR incident. This would include text in free form / standard formats; transfer of waypoints / route information⁵ for display on on-board equipment; transfer of GIS information / search patterns; images; etc.

The VDES can be used in SAR planning, execution and decision making.

3.1.1. SCENARIO - DISTRESS COMMUNICATIONS – DISTRESS RELAY

Once a distress alert is initiated and the information has been forwarded to a Rescue Coordination Centre (RCC) through the established GMDSS process, the RCC forwards information of the incident to vessels in the area. The forwarding of information, using existing formats, could be provided by various communications means, including VDES. The forwarding of data over a digital communications system such as VDES could facilitate the integration

⁵ IEC standard 61174 Ed. 4 includes route exchange.



and display of information on external systems onboard (for example, Radar, ECDIS). Information could then be passed to the RCC and other vessels in the area including course to intercept, ETA on-scene, on-scene conditions, sharing of a common operating picture, etc.

3.1.2. SCENARIO - SAR OPERATIONS – INITIATE SEARCH / RESPONSE

SAR Mission Co-ordinator (SMC) develops response to SAR using resources, search plan, etc. Information to prosecute SAR operation is transmitted to the On Scene Commander (OSC) and SAR response units (SRU) (for example information on resources, plan, waypoints for search pattern, SRU responsibilities, etc.). This could be done using VDES, providing a common operating picture and information using standard templates and formats.

3.1.3. SCENARIO - SAR OPERATIONS – INFORMATION EXCHANGE

During a SAR mission, the OSC and SRU provide regular updates on the search / response to the SMC. In addition, the OSC and SRU share information between each other to facilitate the response. The VDES could be used to exchange information on the SAR plan, SAR execution and other pertinent information to facilitate SAR operations. Information could be automatically integrated with, and portrayed on, external systems both ashore and onboard, including the RCC GIS, decision planning and support systems.

Using information from other systems, such as vessel route, information provided could be tailored to be relevant for the vessel based on its route.

In addition, the OSC and SRU could share information between each other to facilitate the response.

3.1.4. SCENARIO - TELE-MEDICAL

A tele-medical happens when a person is injured or sick onboard a vessel or platform and there is a need to communicate with a doctor ashore for medical assistance and prognosis. The conversation with doctor could be by voice, with transfer of images / photos / indication from medical equipment on patient's condition. VDES could be used to transfer advice, images or other information. Where there are language difficulties, VDES could assist with machine to machine communications and/or language independent communication. Information exchange could be integrated with, and portrayed on, external systems onboard or ashore (medical facility).

3.1.5. SCENARIO - MEDEVAC

A MEDEVAC may be necessary to evacuate a severely injured or sick person. VDES may be used to exchange pertinent medical information from the ship to the SRU and destination medical facility. The SAR Mission Co-ordinator (SMC) develops the response to prosecute the MEDEVAC and could use VDES to provide the plan to the ship and responding unit. Information on the status of the patient could be transferred during the MEDEVAC, both voice and from medical equipment on the SRU.

3.2. SAFETY RELATED INFORMATION

Information regarding safety of navigation and protection of the environment can be transmitted through the VDES.

This includes Maritime Safety Information (MSI) as defined in IMO SOLAS V, regulation 4 (navigational warnings), SOLAS V, regulation 5 (meteorological services and warnings) SOLAS V, regulation 9 (hydrographic services) and SOLAS V, regulation 31 (Danger Messages). Other references include MSC.1/Circ.1287 rev1; MSC.1/Circ.1288; (additional reference COMSAR Cir.15) the IMO Worldwide Radionavigation System IMO resolution A.706(17) (as amended) sets out the Worldwide Radionavigation System (WWRNS).

Near real-time information on meteorological and hydrographical information may be provided.

In this use case information shall be transmitted in standardised formats that can take advantage of the VDES capabilities (for example - IHO S-124 formats).

The requirement includes the ability to send information to a predetermined area (i.e. NAVAREA and METAREA) or an area of particular interest defined by administration.



3.2.1. SCENARIO - METEOROLOGICAL SERVICES AND WARNINGS / NAVIGATIONAL WARNINGS

It is important to have up to date information on the weather that can be expected along a ship's planned route. VDES could be used to facilitate information exchange relating to the route of the vessel, integrated with, and portrayed on external systems onboard.

3.2.2. SCENARIO - WEATHER OBSERVATIONS

Ships may participate in the provision of weather observations, as noted in MSC.1 Circ. 1293. This is a voluntary observing ship (VOS) scheme with information provided to the World Meteorological Organisation. VDES could facilitate this reporting, with information provided directly from onboard sensors.

3.2.3. SCENARIO - ICE MAPS

Information on sea ice conditions around a vessel is important to help ensure safe passage at sea. Knowledge of areas with sea ice along a ship's planned route allows ships to find the most efficient route at an early stage. Together with prognoses for expected ice movements, ice charts allow mariners to plan ahead and significantly reduce the risk of vessels becoming ice locked. VDES could be used to provide this information, which could then be integrated with, and portrayed on external systems onboard. In addition, information on the latest version of ice maps may be provided from mobile station to mobile station.

3.2.4. SCENARIO - NOTICES TO MARINERS

Notices to mariners are a means to disseminate navigational safety information (as part of maritime safety information). SOLAS V, Regulation 9 (Hydrographic Services) notes that administrations should undertake to arrange the dissemination and update of all nautical information necessary for safe navigation (for example, predictive and real-time tides and currents). VDES could be used to provide this information, and changes to information, with respect to the waterway.

3.2.5. SCENARIO - GNSS AUGMENTATION

SOLAS Chapter V, Regulation 19 notes that all ships, irrespective of size shall have a receiver for a global navigation satellite system or a terrestrial radio navigation system, or other means, suitable for use at all times throughout the intended voyage to establish and update the ship's position by automatic means. IMO Resolutions A.915(22) and A.953(23) provide the requirements for Maritime Radionavigation Systems. Distribution of GNSS augmentation corrections via VDES could allow GNSS users to get timing, integrity data and improved position accuracy.

3.2.6. SCENARIO - CROWD SOURCED INFORMATION

Information from users or ship systems may enhance and/or validate meteorological hydrological and hydrographic information that is made available to other vessels in the area and authorities. VDES could be used to facilitate crowd sourced information.

3.3. SHIP REPORTING

Ship reporting can include mandatory and voluntary reports required for a number of purposes by vessels to various shore authorities. Information on ship reporting is provided in IMO SOLAS V, regulation 11 (ship reporting systems), 19-1 (LRIT), regulation 31 (danger messages), regulation 32 (information required in danger messages), MARPOL and SAR Convention, Chapter 5. Additional information on ship reporting is contained in Resolution A.851(20) and FAL.5/Circ.36.

Information forwarded through VDES may transfer the reports for integration into national and/or regional systems could be sent by VDES. (i.e. SafeSeaNet, VTS). Information may also be sent to the ship agent or owner or a service provider.

3.3.1. SCENARIO - SUBMIT ARRIVAL NOTICE

A notice of arrival report is based on known content and could be set in a template form. The aspects of the template report, such as information on the ship particulars, would be pre-populated. Where possible, additional



information related to the voyage, such as destination, ETA destination, last port(s) could be populated from other systems that contain such information. Other information that may be provided include ISPS reports; ship crew information; information specifically required by the shore authority. This may be submitted using data populated automatically from other systems or may require manual input by the mariner. VDES could facilitate exchange of information using existing formats.

3.3.2. SCENARIO - SUBMIT UPDATED INFORMATION

As the voyage continues, updated information will be provided. This can include updated estimated time of arrival; change in condition of the vessel; change in route of the vessel. This is a user defined report, which could be based on a set template for 'updated information' or free-text report. VDES could facilitate exchange of information using existing formats. The vessel may be interrogated for information on request, based on its route, operating area or position.

3.3.3. SCENARIO - PROVIDE INITIAL REPORT TO SHORE (PRIOR TO DEPARTURE)

Prior to departure specific, standard information is required. This may include information required for clearance to depart. Reports could be pre-populated from available information where possible. Specific information may be required to be entered manually.

3.3.4. SCENARIO - SECURE SHIP REPORTING

There can be times when it is necessary for secure ship reporting, including times when the vessel may switch off AIS. Using VDES, information could be forwarded through a secure communications link.

3.3.5. SCENARIO - DANGER MESSAGE

The Master of a vessel is required to report dangerous conditions (SOLAS V, regulation 31 and 32), such as: dangerous ice, derelicts, dangers to navigation, tropical storm, severe weather, ice accretion. VDES could facilitate the provision of this information to both shore authorities and other vessels in the area. Information exchange may be integrated with, and portrayed on, external systems onboard.

3.4. VESSEL TRAFFIC SERVICES

Vessel Traffic Services is included in SOLAS Chapter V, Regulation 12, with further information in IMO Resolution A.857(20). Three key services provided by VTS are:

- 1 Information Service.
- 2 Navigational Assistance Service.
- 3 Traffic organisation Service.

An Information Service involves maintaining a traffic image and allows interaction with traffic and response to developing traffic situations. An Information Service should provide essential and timely information to assist the on-board decision-making process.

Information required by the VTS can be both standardised (supported by templates) or specific to a situation.

VTS involves maintaining a vessel traffic image, and relies on vessel tracking from sensors such as radar, AIS, CCTV, other VTS centres. The vessel traffic image may be supplement with crowd-sourced information from vessels data (sensor data from ships provided to the shore to expand the traffic image range).

VTS also requires interaction with traffic to respond to developing traffic situations.

VTS relies on the ability to provide essential and timely information; monitor the actions of vessels in the VTS area, including monitoring routes and changes in route; interacting with other VTS centres in the region; interact with other port agencies (allied services).

Ports may also provide a specific Local Port Service (LPS) where it is deemed through a risk assessment that a VTS is not required.

3.4.1. SCENARIO - WATERWAY MONITORING

VTS provides monitoring and other services. VDES may be used to monitor vessels and autonomously provide information to these vessels based on predetermined parameters as defined by the shore authority. In addition, VDES may enable sharing of information on synthetic VTS targets from the VTS to vessels transiting the VTS area. Information exchange may be integrated with, and portrayed on, external systems ashore and onboard.

3.4.2. SCENARIO - INFORMATION SERVICE

Information Service (INS) is provided by broadcasting information at fixed times and intervals or when deemed necessary by the VTS, or at the request of a vessel. The information provided may include safety information as previously defined. Additional information could include specific limitations for navigation in the VTS area (for example manoeuvrability limitations; draft restrictions; channel closures; diving operations). Information exchange may be integrated with, and portrayed on, external systems ashore and onboard.

3.4.3. SCENARIO - NAVIGATIONAL ASSISTANCE SERVICE

The navigational assistance service (NAS) is defined by IMO as ‘a service to assist on-board navigational decision-making and to monitor its effects’. NAS may be provided on request by a vessel in circumstances such as equipment failure or navigational unfamiliarity. VDES could be used in the exchange of information during the provision of NAS. Information exchange may be integrated with, and portrayed on, external systems ashore and onboard.

3.4.4. SCENARIO - TRAFFIC ORGANISATION SERVICE

The traffic organisation service (TOS) is defined by IMO as ‘a service to prevent the development of dangerous maritime traffic situations and to provide for the safe and efficient movement of vessel traffic within the VTS area’. The purpose of the TOS is to prevent hazardous situations from developing and to ensure safe and efficient navigation through the VTS area. VDES could be used to exchange this information. Information exchange may be integrated with, and portrayed on, external systems ashore and onboard.

3.5. CHARTS AND PUBLICATIONS

IMO SOLAS Chapter V, Regulation 27 (nautical charts and nautical publications) notes that charts and publications necessary for the intended voyage shall be adequate and up to date.

The aim of nautical chart and publication services are to safeguard navigation at sea by providing information such as nature and form of the coast, water depth, tides table, obstructions and other dangers to navigation, location and type of aids to navigation.

The nautical chart and publication services ensure the official distribution, update and licensing of electronic charts and publications to vessels and other users.

Nautical publications include list of lights, sailing directions, tide and current tables, etc.

There may be a requirement for a ‘user pay’ aspect for some services (i.e. ENC updates).

3.5.1. SCENARIO - UPDATES LINKED TO A SHIP'S ROUTE

An example of this would be a vessel proceeding to a specific location. At the time of sailing, the vessel had all required charts and publications for the voyage. These charts and publications were the most up to date at the time of sailing, however some information may have changed during the voyage. Updated information could be provided through VDES as the vessel as it continues on its voyage, providing information based on the route of the vessel, and limiting the updates to only that information that has changed. Information exchange may be integrated with, and portrayed on, external systems ashore and onboard.

3.6. ROUTE EXCHANGE

The development of e-navigation has highlighted the opportunity to make effective use of digital data exchange to support safe and efficient vessel movements. Projects such as Mona Lisa, EfficienSea and ACCSEAS have included the development of route exchange. (IEC 61174 edition 4 annex S refers.)

Route exchange could enhance safety by providing early indication of changes in route which may be due to fatigue, weather conditions, or condition of the vessel (possible malfunction).

The use of route exchange could assist with fleet management, whereby information on routes can be exchanged with shore personnel as well as other vessels in the fleet.

In addition, the use of route exchange could assist with route and speed optimisation based on weather and currents; just in time arrival and traffic congestion.

VDES has the ability to provide the communications medium for digital data exchange.

3.6.1. SCENARIO - SHIP TO SHIP

This scenario is outside of VTS coverage areas, noting that within a VTS area, route exchange would be through the VTS. Ship to ship route exchange would assist vessels on a transit by predicting when interactions may occur. VDES could assist in the exchange of digital data to facilitate ship to ship route exchange.

3.6.2. SCENARIO - SHIP TO SHORE

To inform shipping and other waterway users of possible hazardous situations shore authorities need information about the intentions of the waterway users, such as their intended route. Based on this information the authorities could organize traffic and, when needed, recommend other routes/possibilities for a safer passage and also provide information about the waterway.

3.6.3. SCENARIO - SHORE TO SHIP

Before ships enter a sea area monitored by a shore authority, information about this area could be provided to assist in a safe and efficient passage. If the route of the vessel is known, information can be tailored to the route. The shore authority could link the vessel planned route with other information received, such as cargo, and adjust the information as may be required. Route plans received from ships can be used for detecting possible traffic congestions and high risk situations in advance. Shore authorities can also send alternative route recommendations to ships when needed. This allows ships to choose the route that is most suitable for its navigation. VDES can facilitate reception of route plans which may be integrated with, and portrayed on, external systems ashore.

3.6.4. SCENARIO - NAVIGATIONAL DISRUPTION

There may be some event or circumstance that impacts the normal operation of the waterway requiring urgent traffic management to ensure continuity of operations. VDES could be used to share information on the circumstance, and proposed alternate routing could assist in effective movement of vessels throughout the incident.

3.7. LOGISTICS / SERVICES

When sailing from berth to berth before, during and after the voyage there are several logistical aspects that must be addressed. Most of these are done by an agent on the shore but are changed because of different reasons. The means of communicating these logistical aspects would depend on the location of the ship / shore elements involved and could include VDES. In cases where cargo is transferred at sea (transshipment) the location could be out of range of other communications and VDES would be the preferred communication exchange platform.

Information transfer could assist with efficiency of the overall cargo chain (for example the MonaLisa Sea Traffic Management (STM) concept).

Sharing of route information could assist with allied services related to shipping and ship movements - this could include locks, pilotage, tug allocation, shore resources, and other logistical aspects. This use case represents the business to business aspect.

Logistical elements where VDES may be an appropriate communication method include:

- Transfer of vessel loading plan;

- Tug operations;
- Pilotage operations;
- Stores / supplies / ship bunkers required; waste removal.

3.7.1. SCENARIO - LOGISTIC SERVICES – SHIP TO SHORE

Ship arriving at a port forwards revised time of arrival and requests confirmation for stores, fuel, access to waste facilities. Vessel also requires information on pilots and tugs and other aspects for the transit. VDES provides an opportunity for automated exchange of information to support these types of requests.

3.7.2. SCENARIO - LOGISTIC SERVICES – SHORE TO SHIP

As the ship arrives, the shore authority will provide confirmation regarding offloading, loading of the vessel and respond to requests from the ship. VDES provides an opportunity for automated exchange of information to support these types of requests.

4. DEFINITIONS

The definitions of terms used in this Guideline 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.

5. ACRONYMS

| | |
|---------|---|
| ACCSEAS | Accessibility for Shipping, Efficiency, Advantages and Sustainability (EU research project) |
| AIS | Automatic Identification System |
| AIS 1 | AIS Default Channel 1 - 161.975 MHz (Ch. 87B//2087) |
| AIS 2 | AIS Default Channel 2 - 162.025 MHz (Ch. 88B/2088) |
| App | Application |
| ASM | Application Specific Messages |
| BBM | Broadcast Binary Messages |
| BITE | Built in test equipment |
| CCTV | Closed-Circuit Television |
| Circ. | Circular (IMO document) |
| COMSAR | Sub-Committee on Communications and Search and Rescue (IMO) |
| DSC | Digital Selective Calling |
| ECDIS | Electronic Chart display & Information System |
| ENC | Electronic Navigation Chart |
| ETA | Estimated Time of Arrival |
| FAL | Facilitation Committee (IMO) |
| FEC | Forward error correction |
| GIS | Geographic Information System |
| GMDSS | Global Maritime Distress and Safety System |
| GMSK | Gaussian Minimum Shift Keying |
| GNSS | Global Navigation Satellite System |
| IAMSAR | International Aeronautical and Maritime Search and Rescue (manual) |
| IEC | International Electrotechnical Commission |



| | |
|---------|---|
| IHO | International Hydrographic Organization |
| IMO | International Maritime Organization (UN) |
| INS | Information Service |
| ISPS | International Ship and Port Facility Security [Code] |
| ITU | International Telecommunication Union |
| ITU-R | International Telecommunication Union-Radiocommunication Sector |
| kbps | kilobits per second |
| kHz | kilohertz |
| LPS | Local Port Service |
| LRIT | Long Range Identification & Tracking |
| MARPOL | International Convention for the prevention of pollution from ships (IMO 1973 as amended) |
| MAS | Maritime Assistance Service |
| MEDEVAC | Medical evacuation |
| METAREA | Geographical sea region for the purpose of co-ordinating the transmission of meteorological information |
| MHz | megahertz |
| MMSI | Maritime Mobile Service Identity |
| MSC | Maritime Safety Committee (IMO) |
| MSI | Maritime Safety Information |
| MSP | Maritime Service Portfolio(s) |
| OSC | On-scene commander |
| NAS | Navigation Assistance Service |
| NAVAREA | Geographic area in which various governments are responsible for navigation and weather warnings |
| NAVTEX | Navigational Telex (service) |
| NCSR | Navigation, Communications and Search and Rescue (IMO Sub-Committee) |
| RCC | Rescue Co-ordination Centre |
| RR | Radio Regulations |
| RTCM | Radio Technical Commission for Maritime Service |
| SAR | Search and Rescue |
| SART | Search and Rescue Transponder |
| SAT | Satellite |
| Serv | Server |
| SIP | Strategic Implementation Plan |
| SOLAS | International Convention for the Safety of Life at Sea, (IMO 1974 as amended) |
| SRU | Search and Rescue Unit |
| TDMA | Time-division multiple access |
| TMAS | Telemedical Maritime Assistance Service |
| TOS | Traffic Organization Service |
| UTC | Co-ordinated Universal Time |
| VDE | VHF Data Exchange |
| VDES | VHF Data Exchange System |
| VDL | VHF Data Link |



| | |
|-------|---|
| VHF | Very High Frequency (30 MHz to 300 MHz) |
| VOS | Voluntary observing ship |
| VTs | Vessel Traffic Information Service |
| WRC | World Radiocommunications Conference |
| WWRNS | World-wide Radionavigation System |

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