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| sub-committee on navigation, communications and search and rescue  11th session  Agenda item 9 | NCSR 11/9/X  DD March 2024  Original: ENGLISH  Pre-session public release: |

**Development of amendments to SOLAS chapters IV and V and performance standards and guidelines to introduce VHF Data Exchange System (VDES)**

**Report of the Correspondence Group**

**Submitted by JAPAN**

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| **SUMMARY** | |
| *Executive summary:* | This document provides the report of the Correspondence Group on VHF Data Exchange System (VDES). |
| *Strategic direction, if applicable:* | 2 |
| *Output:* | 2.28 |
| *Action to be taken:* | 22 |
| *Related documents:* | SOLAS Chapter IV and V, NCSR 10/22, NCSR 11/6 |

**Background**

1. The Sub-Committee on Navigation, Communication and Search and Rescue (NCSR), at its tenth session, established a correspondence group on VHF Data Exchange System (VDES) under the coordination of Japan (NCSR 10/22, paragraph 6.12).
2. The coordinator of the Correspondence Group (the Group) would like to thank the representatives of the following Member States and the observers for their participation in the Correspondence Group: Australia, Canada, China, Denmark, Finland, Germany, Ireland, Japan, Netherlands (Kingdom of the), New Zealand, Norway, Republic of Korea, Russia, the United Kingdom, the United States, EC, INTERTANKO, IALA, ITF and IMSO.
3. The Group undertook the consideration of matters included in its terms of reference, taking into account the comments and decisions made at NCSR 10. The Group conducted its work by correspondence and also convened three virtual meetings, as a complement to the usual email correspondence.
4. In accordance with its terms of reference, the Group submitted an interim report to the nineteenth meeting of the Joint IMO/ITU Experts Group on Maritime Radiocommunication Matters (IMO/ITU EG 19). After consideration of the Group’s interim report, IMO/ITU EG 19 invited the Coordinator of the Correspondence Group to further progress the development of the necessary draft amendments to SOLAS, draft VDES performance standards, and other related instruments for the introduction of VDES into SOLAS, taking into account the views expressed by the IMO/ITU Experts Group, and submit a final report to the NCSR Sub-Committee, for consideration (NCSR 11/6, annex, paragraph 6.7).

**Analysis**

1. The Group undertook a technical, regulatory and operational analysis of VDES, taking into account the user interface, human element, financial implications and other matters, as presented in annexes 1 and 2. The key findings of the analysis were as follows:
2. the automatic identification system (AIS) is a core component of VDES and it is technically identical with the existing AIS therefore, VDES could serve as a substitute for AIS within SOLAS chapter V;
3. other components of VDES function as radiocommunication means so they need to be regulated under SOLAS chapter IV;
4. according to the ITU Radio Regulations, the channels allocated to application specific messages (ASM) and the terrestrial component of VHF data exchange (VDE-TER) are on a primary basis and the channels allocated to VDE-SAT are on a secondary basis;
5. VDES may serve various communication needs;
6. proper training is essential for seafarers and shore-side operators;
7. mandated and harmonized means for presentation and operation would enable efficient applications for e-navigation; and
8. it is essential to consider sufficient means of cyber security.

**Draft performance standards**

1. Based on the outcome of the analysis, the Group developed the draft VDES performance standards, as set out in annex 3 but there were still some issues that could not be resolved by the submission of this report.
2. For example, the subject of these performance standards was a shipborne radiocommunication equipment that exchanges digital data between another VDES equipped vessel, shore station or satellite but the Group agreed that VDES should be considered as a whole communication system that included other data input and output devices, applications for processing data etc. and should be worked as a whole communication system. Some participants proposed to include system-related requirements in the performance standards (annex3, section 7 refers) while other participants were of the view that such information should be made available in another instrument such as a guideline.
3. Another example was message priorities (annex3, paragraph 1.5). Some participants proposed that VDES should support four message priorities comprised of SOLAS Chapter IV and the ITU-R Radio Regulations, distress, urgency, safety and other/general communication but other participants indicated that this could cause confusion and conflict with Recommendation ITU-R M.2092 according to which, VDES should give its highest priority to the AIS position reporting and safety related information.
4. As a result, the Group was of the view that further considerations and progress were needed for the finalization of the draft performance standards.

**Operational guidelines**

1. In parallel with the development of the draft performance standards, the Group developed the draft guidelines for the operational use of VDES, as set out in annex 4.
2. However, the Group noted that the draft guidelines were not ready for the finalization and further work was needed like the draft performance standards.

**Amendments to SOLAS Chapter V**

1. The Group considered five amendment options to SOLAS regulation V/19.2.4 to introduce VDES as a carriage requirement, as follows:
2. “All ships of 300 gross tonnage and upwards engaged on international voyages and cargo ships of 500 gross tonnage and upwards not engaged on international voyages and passenger ships irrespective of size shall be fitted with an automatic identification system (AIS) or VHF data exchange system (VDES), as follows”;
3. “All ships of 300 gross tonnage and upwards engaged on international voyages and cargo ships of 500 gross tonnage and upwards not engaged on international voyages and passenger ships irrespective of size shall be fitted with an automatic identification system (AIS) or other means, as follows”;
4. “All ships of 300 gross tonnage and upwards engaged on international voyages and cargo ships of 500 gross tonnage and upwards not engaged on international voyages and passenger ships irrespective of size shall be fitted with an automatic identification system (AIS), VHF data exchange system (VDES) or other means, as follows”;
5. “All ships of 300 gross tonnage and upwards engaged on international voyages and cargo ships of 500 gross tonnage and upwards not engaged on international voyages and passenger ships irrespective of size shall be fitted with an automatic identification system (AIS) or other means including AIS functionality, as follows”; and
6. “All ships of 300 gross tonnage and upwards engaged on international voyages and cargo ships of 500 gross tonnage and upwards not engaged on international voyages and passenger ships irrespective of size shall be fitted with ~~an automatic identification system (AIS)~~ a VHF data exchange system (VDES), as follows” (followed by proposed implementation dates).
7. The Group could not reach an agreement which option was the best but noted that regardless of which option was chosen, the consequential amendment to other IMO instruments such as record of equipment for passenger ship safety (form P) would be necessary. The Group also noted that if the option 5 was chosen, VDES would become a mandatory carriage requirement under SOLAS Chapter V.
8. In addition, the Group was of the view that regulations V/19.2.4.1 to 19.2.4.3, specifying the initial implementation dates for AIS carriage requirement, were no longer necessary.

**Amendments to SOALS Chapter IV**

1. One participant proposed the following draft amendments to SOLAS Chapter IV as basis for the implementation of Option 2 in paragraph 11 supported by a number of other participants.

“Regulation 7-1

1. All ships of 300 gross tonnage and upwards engaged on international voyages and cargo ships of 500 gross tonnage and upwards not engaged on international voyages and passenger ships irrespective of size engaged on all voyages shall be fitted with an VHF Data Exchange System (VDES), as follows:

.1 ships constructed on or after 1 January 2028[[1]](#footnote-1);

.2 ships engaged on international voyages constructed before 1 January 2028:

.1 in the case of passenger ships, not later than 1 January 2029;

.2 in the case of tankers, not later than the first survey+ for safety equipment\* on or after 1 January 2029;

.3 in the case of ships, other than passenger ships and tankers, of 50,000 gross tonnage and upwards, not later than 1 January 2030; and

.4 in the case of ships, other than passenger ships and tankers, of 300 gross tonnage and upwards but less than 50,000 gross tonnage, not later than the first safety equipment survey\*\* after 1 January 2030 or by 1 July 2030, whichever occurs earlier;

.3 ships not engaged on international voyages constructed before 1 January 2028, not later than 1 January 2034; and

.4 the Administration may exempt ships from the application of the requirements of this paragraph when such ships will be taken permanently out of service within two years after the implementation date specified in subparagraph .2 and .3;

2. The Administration shall determine to what extent the provisions of this Regulation do not apply to the following categories of ships:

.1 Passenger ships below 150 gross tonnage engaged on any voyage;

.2 Passenger ships below 500 gross tonnage not engaged on international voyages.

3. VDES shall be operated taking into account the guidelines adopted by the Organization.\*\*\* Ships fitted with VDES shall maintain VDES in operation at all times except where inter-national agreements, rules or standards provide for the protection on navigational information.”

1. Regarding the proposed implementation dates, the Group considered that confirmation from the equipment manufacturers should be sought through IEC and CIRM in order to ensure the availability of VDES in the market by the proposed dates taking into account the final date for publication of the SOLAS amendment and of the VDES performance standards.
2. However, some participants were of the view that the amendments to SOLAS Chapter IV for the mandatory carriage requirement were premature as VDES could only be used for exchange of general radiocommunications and not GMDSS communications at this time. The same participants also noted that under SOLAS Chapter IV, the VDES channels are not protected by the ITU-R Radio Regulations Appendix 15. Though the participants understood that MSC 103 instructed the Sub-Committee to amend SOLAS Chapter IV and V, some participants did not support the proposed draft amendments to SOLAS Chapter IV.
3. The Group noted that the decision of the carriage requirement under SOLAS was the authority of the Committee and considered that a confirmation to the Committee on this issue would may be needed for the further progress of the work.

**Other matters for consideration**

1. In addition to the above-mentioned issues, some participants indicated that the following matters should also be considered:
2. carriage requirement for fishing vessels, i.e. any consequential amendments to the Cape Town Agreement of 2012; and
3. cyber security aspects of VDES, for example, cost and method for distribution of public key infrastructure (PKI), fraudulent usage of MMSI on AIS, etc.

**IMO Space**

1. The Group would like to thank the Secretariat for making IMO Space available. The Group actively used the web-based work space to facilitate its deliberations and found it very useful, in particular for document sharing and distribution as well as notifying Group participants when a new document was uploaded or a comment was made on an existing document.
2. From the coordinator’s point of view, the following improvements were suggested:
3. since a correspondence group normally worked round by round, creation of file by each round would be beneficial; and
4. online meeting host capability could be introduced.

**Action requested to the Sub-Committee**

1. The Sub-Committee is requested to note the report of the Correspondence Group on VDES and consider:
2. seeking clarification from the Committee on the introduction of VDES in SOLAS as a mandatory carriage requirement for ships (paragraph 13, 17 and 18); and
3. taking into account the further work required, inviting the Committee to extend the target completion year of the associated output to 2025.

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ANNEX 1

VDES analysis sheet

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| Component | Technical/ Functions/ Communication capabilities (IALA) | Regulatory | Operational | User Interface (visualization/input) (Germany) (IALA) | Others |
| AIS | (Channel)   * AIS1, 2 * Ch. 75, 76 (long range) * Ch. 70 (DSC)   (Rate)   * 9.6 kbps (GMSK)   (Range)  (def. 12.5 W; low 1W)  Definition for conditions to use low power (Germany)   * AIS position reporting (IALA) * ASM exchange (IALA) * Broadcast/ addressed (IALA) | (IMO)   * SOLAS V/19 * Res.A694(17) (Japan) * Res.A1106(29) (China) * Res. MSC.74(69) * MSC.1/Circ.1252 (China) * SN.1/Circ.227 (China) | * Identification * Navigation Status * Type of Vessel * Situation awareness (Collision avoidance) (Germany) * To obtain information about a ship and cargo * VTS tool * General requirements (Japan) * Aids to Navigation information provision (Japan) * AIS-AtoN (physical and virtual) (IALA) * Locating signal transmission for Search and Rescue operation (Japan) * Some limited capacity for ASM message according to IMO SN.1/Circ.289 on AIS 1 and 2 (and regional ASMs) (IALA) * Do not have any cyber security measures (IALA) | AIS Data as defined in 1371 (Germany)  Requirement for Pilot-Plug (Germany)  Standard AIS Presentation Interface (PI) sentences are defined in IEC 61162-1 (Finland)  Portrayal of AIS targets and other data received via AIS on shipborne navigational display is defined in SN.1/Circ.243 and IEC 62288 (Finland) | (Human element)   * The followings are general implication on human factor. However, exacerbated in SAR situation:   -Language barrier exists  -Limited means of information exchange (ITF)   * User friendly presentation depends on other equipment e.g. radar (Germany)   (Financial implication)   * Communication cost is free other than procurement, installation and maintenance of the equipment * Relevance of cost implication questionable as MSC has decided a mandatory carriage requirement (Germany) |
| (ITU)   * R.R. Appendix 15 (AIS-SART) * R.R. Appendix 18 (Primary allocation) * Rec. ITU-R M.1371-5 |
| ASM | (Channel)   * ASM1(2027), ASM2(2028)   (Rate)   * 9.6 ksps (π/4-QPSK)   (Range)  (def. 12.5 W; low 1W)  Definition for conditions to use low power (Germany) | (IMO)   * SN.1/Circ.289 * SN.1/Circ.290 (China) | * Exchange of the data content defined by the application (RoK) * Hydrographic/Meteorological data provision (Japan) * Notice to mariners (Japan) * Port operation/Port approach tool (Japan) * No mandatory set of messages defined by IMO. (Germany) | * Definition of data to be moved from AIS 1 and AIS2 to ASM channels and related conditions to do so. (Germany)   ASM for Nav-COM-Equipment is not defined by IMO – this has to be specified by IMO for each Nav-/Com equipment\* as VDES has been identified as carriage requirement (Germany) | * SN.1/Circ.289 only describes how to compose the messages (to fit the information into AIS channel with GMSK 9600 bit/s modulation), There should be guidelines on how to transmit and receive ASMs defined in SN.1/Circ.289 in the ASM channels (Japan)   (Financial implication)   * Relevance of cost implication questionable as MSC has decided a mandatory carriage requirement (Germany) |
| (ITU)   * R.R. Appendix 18 (Primary allocation) * Rec. ITU-R M.2092-1 * No entry in App. 15 Excl. of GMDSS and MSI (Germany) |
| VDE-TER | (Channel)   * 1024, 1084, 1025, 1085 * 2024, 2084, 2025, 2085   (Rate)   * 19.2 ksps (25kHz BW) (π/4-QPSK, 8-PSK, 16-QAM) * 38.4 ksps (50kHz BW) (π/4-QPSK, 8-PSK, 16-QAM) * 76.8 ksps (100kHz BW) (π/4-QPSK, 8-PSK, 16-QAM)   (Range)  shipborne VDES transceivers (def. 12.5 W; low 1W)  Definition for conditions to use low power  VDES base stations (50 W) (Germany) | (IMO)  None | * Exchange of data btw maritime stations(4S) (RoK) * No mandatory set of messages defined by IMO. (Germany) | Data on VDE-TER for Nav-/COM-Equipment is not defined by IMO – this has to be specified by IMO for each Nav-/Com equipment\* as VDES has been identified as carriage requirement (Germany) | (Financial implication)   * Relevance of cost implication questionable as MSC has decided a mandatory carriage requirement (Germany) |
| (ITU)   * R.R. Appendix 18 (Primary allocation) * Rec. ITU-R M.2092-1 * No entry in App. 15 Excl. of GMDSS and MSI (Germany) |
| VDE-SAT | (Channel)   * 1024, 1084, 1025, 1085, 1026, 1086 * 2024, 2084, 2025, 2085, 2026, 2086   (Rate)  Uplink   * 2.1 ksps (50kHz BW) (QPSK/CDMA) * 33.6 ksps (50kHz BW) (π/4-QPSK, 8-PSK, 16-QAM)   Downlink   * 4.2 ksps (50kHz BW) (BPSK/CDMA) * 33.6 ksps (50kHz BW) (π/4-QPSK, 8-PSK) * 36.0 ksps (100kHz BW) (BPSK/CDMA) * 56.4 ksps (150kHz BW) (BPSK/CDMA) * 4.2 ksps (50kHz BW) (BPSK/CDMA) * 33.6 ksps (50kHz BW) (BPSK, π/4-QPSK)   (Range)   * 600 – 2800 km dep on sat constellation (Germany)   shipborne VDES transceivers (12.5 W) (Germany) | (IMO)  None | * Exchange of data btw ship to satellite and satellite to ship (RoK) * Relaying of data btw satellite and ground station operated by the satellite service provider (RoK) * What type of service can be sent via a secondary link, which has to accept interference from other sources? (Germany) | Data on VDE-SAT for Nav-/COM-Equipment is not defined by IMO – this has to be specified by IMO for each Nav-/Com equipment\* as VDES has been identified as carriage requirement (Germany) |  |
| (ITU)   * R.R. Appendix 18 (Secondary allocation) * Rec. ITU-R M.2092-1 * No entry in App. 15 Excl. of GMDSS and MSI (Germany) |
|  |  |  |  | \*Modifications of related Performance-Standard may be required |  |

Overarching comment on ASM, VDE-TER and VDE-SAT regarding operational issue from ITF

* Applications to operational functions of this technology could be abundant, such as:
* VTS
* GMDSS, such as sending distress relay
* Meteorological information
* Cargo movement
* GMDSS record keeping
* Any operations of e-Navigation could be applied

Overarching comment on ASM, VDES-TER and VDE-SAT regarding human element from ITF

* The adaptation process could be less demanding as the system already encompasses AIS
* Once SOLAS V is amended, further inclusion to SOLAS Ch IV needed as well as relevant training curriculums/syllabi will be essential. Following measures are proposed:

-Amendments to the STCW Section A-II/1 table regarding the use of ECDIS, by including VDES with AIS related competences

-Revising model course 1.34 *Automatic Identification Systems (AIS)* to expend VDES; or developing a new model course

* ASM services are connected to the shore side. Thus, shore side operations to be clearly identified. As well as, operational trainings depending on the system’s application will be critical
* Security aspects should not be overlooked in connection with cargo and ship identification.
* Enhancing the quality of information received and sent out to and from the ship, i.e. intentional blocking of signals (Jamming) and data encryption (spoofing) ability could alleviate security concerns from AIS, so benefitting officer in charge.
* Overcoming language barriers
* Usage of graphic aids

Overarching comment on AIS, ASM, VDE-TER and VDE-SAT regarding technical issue from Japan

* Since the provisions regarding satellite operations and the satellite station side are not yet clear, the "range" could be removed from each item.

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ANNEX 2

Technical, regulatory and operational analysis of VDES,  
 including human elements, financial implications and others

1. Summary

The VHF Data Exchange System (VDES) is a maritime radio communication system that operates within the VHF maritime mobile band and consists of four main components: AIS, Application Specific Messages (ASM), VDE-TER (terrestrial) and VDE-SAT (satellite). This analysis of VDES is undertaken to consider the implication of introducing VDES into the 1974 SOLAS Convention and conducted by the correspondence group established at the 10th session of the IMO NCSR Sub-Committee and took into account the technical, regulatory and operational issues including human elements, financial implications and other relevant aspects.

1. Technical analysis

VDES generally achieves higher data transmission rates than AIS by employing wider bandwidths and advanced modulation methods. In a 100kHz channel, VDE-TER, specifically, achieves a maximum raw data rate up to 32 times greater than AIS. However, the use of higher-order modulation methods may lead to a reduction in operational range. The VDE-SAT has the potential to offer global coverage, contingent on satellite orbits and the number of satellites deployed. If VDE-SAT is considered, then interference [of/to] terrestrial signals need to be considered in relation to the service area of the VDE-SAT.

As AIS is used for situation awareness and providing, a constant flow of own ship data and is receiving this from other vessels, therefore, other components should not cause harmful interference to AIS operation. These other components especially ASM and VDE-TER enables the maritime community to reduce the data load on AIS1 and AIS 2 by moving data to be transmitted to these other communication channels ensuring that AIS will be available in the future for its main purpose of safety of navigation.

1. AIS

The AIS is the core communication component of VDES defined in the Annex 3 of the IMO Resolution MSC.74(69) requiring that the technical characteristics should comply with ITU Recommendation ITU-R M.1371-5. AIS operates across two designated channels, known as AIS 1 and AIS 2 as specified in ITU-R Radio Regulations (RR) Appendix 18. Additionally, two supplementary channels, channel 75 and 76, are allocated for long-range (satellite-based) reception of AIS messages. The data transmission rate for AIS is 9.6 kbps, and its operational range is essentially line-of-sight between installations, but may be limited by channel congestion. The transmission power varies based on configuration: 12.5 W for high power and 1 W for low power. At this time, the IMO has not defined when the low power setting should be used. Notably, tankers and other ships use the low-power setting while moored or bunkering to facilitate safe operation during loading and unloading of certain cargo.

1. ASM

The ASM component operates across two channels, with a symbol rate of 9.6 ksps (equivalent to a data rate of 19.2 kbps - twice that of AIS). By incorporating Forward Error Correction (FEC), ASM achieves an operational range comparable to that of AIS. The World Radiocommunication Conference in 2015 defined these channels to be available from 1st January 2019 with the aim of migrating ASM messages away from AIS 1 and AIS 2. Due to the absence of hardware and regulatory framework requirements including IMO agreed transition plan the use of these channels is at present very limited.

1. VDE-TER

The VDE-TER component operates across a total of eight frequency channels, which are 4 converted duplex channels of the ITU RR Appendix 18. VDE-TER employs either individual channels or combinations of two or four consecutive channels to establish three distinct bandwidths: 25 kHz, 50 kHz and 100 kHz. Using various modulation methods, VDE-TER achieves a peak symbol rate of 76.8 ksps, translating to a maximum raw data rate of 307.2 kbps- 32 times higher than AIS. While VDE-TER applies robust FEC codes, the use of higher-order modulation methods such as 8-PSK and 16-QAM, along with a lower average transmission power of [shipborne] VDES equipment (6.5 – 12.5 W), may lead to reduced coverage range.

1. VDE-SAT

The VDE-SAT component employs a total of twelve channels, converted from 6 duplex channels which are allocating six channels each to the lower and upper legs of the ITU RR Appendix 18. Similar to VDE-TER, VDE-SAT combines sets of two, four or six consecutive channels to establish three distinct downlink (satellite -to-ship) bandwidths: 50 kHz, 100 kHz and 150 kHz. Using maximum symbol rate of 33.6 ksps, the uplink achieves a peak data rate of 134.4 kbps via the 16-QAM modulation - a significant 14-fold increase over AIS. Downlink rates vary based on bandwidth and modulation used. The size and shape of the satellite’s footprint depends on the type of satellite antenna used and its orbital altitude. To ensure effective operation, the design of VDE-SAT protocols and equipment must account for factors such as path delay and Doppler effects. The availability of ground stations for continuous download of VDES data/information from satellites with a VDES payload is also important.

1. Regulatory analysis

With the exception of the AIS component, there currently exist no IMO instruments that regulate or provide guidance on the equipment and the use of VDES. Therefore, it is necessary to either develop new IMO instruments or modify existing ones to govern VDES and its usage. While channels for VDES have already been allocated in the ITU RR Article 5 and Appendix 18, they are not yet designated for GMDSS use under Appendix 15. In addition, COMSAR.1/Circ.46 clarifies that AIS text messages are not part of GMDSS. For the introduction of VDES into GMDSS, such as for the purpose of MSI dissemination, amendments to Appendix 15 are required. This would necessitate a request to the ITU and further measures to position VDES appropriately, in addition to developing new IMO instruments similar to NAVTEX manual, EGC manual for the NAVAREA/METAREA Coordinators and MSI providers and modifying existing IMO instruments. Furthermore, it is crucial to exercise caution when introducing VDES, particularly VDE-SAT component, into SOLAS, given that the VDE-SAT channels are allocated on a secondary basis, which excludes the usage within GMDSS as no regulatory protection is provided.

1. AIS

AIS is presently subject to regulation through a range of IMO instruments. Therefore, if IMO embraces VDES, the existing regulations pertaining to AIS will extend to the AIS component of VDES.

In accordance with Recommendation ITU-R M.2092-1, the AIS component of VDES uses the same channels as specified in Recommendation ITU-R M.1371 for AIS. The AIS channels designated within the ITU RR Appendix 18 are allocated under ITU RR Article 5 and recognized for GMDSS use in the ITU RR Appendix 15. However, the GMDSS designation exclusively pertains to AIS-SART applications. In addition, COMSAR.1/Circ.46 clarifies that AIS text messages are no part of GMDSS. If VDES is to replace AIS, then a transition plan would need to be established, considering the voluntary fit vessels that do not have mandated carriage requirements as well as required to under SOLAS V.

1. ASM

The guidance on the use and for the presentation and display of AIS Application Specific Messages (AIS ASM) are provided by IMO SN.1/Circ.289 and 290. These are defining the structure and content of 22 Application Specific Messages that are recommended for international use. At the time of definition these messages were intended to be transmitted via AIS 1 and AIS2. However, the usage and integration of ASM 1 and ASM 2 within ship’s equipment is not specifies and required. Consequently these documents are not directly applicable to the ASM component of VDES and require modification. Apart from the mentioned document, there are currently no IMO instruments to govern the use of ASM. Nonetheless, IALA maintains a collection of additional Application Specific Messages to ensure harmonized usage. These are used at the time in certain regions but it is possible to use them, if identified as useful, in other regions of the world. While regional use is regulated by local authorities and with the implementation of VDES into SOLAS as decided by MSC103, the establishment of an international sharing mechanism by IMO such as using GISIS module becomes desirable.

ITU RR Appendix channels ASM 1 and ASM 2 are allocated under ITU RR Article 5 on primary basis to the MOBILE Service not specifically to the Maritime Mobile Service. However, they are currently not designated for GMDSS use in the ITU RR Appendix 15.

1. VDE-TER

Currently, there exists no IMO instrument to regulate or provide guidance on the use of VDE-TER. Therefore, such IMO instrument should be developed when VDE-TER or VDES as a whole is introduced in SOLAS.

Similar to ASM, the VDE-TER frequencies channels are primarily allocated in the ITU RR Article 5 to the MOBILE Service. This allocation is not specifically to the Maritime Mobile Service and the channels identified by the ITU RR Appendix 18 but not listed in the ITU RR Appendix 15 and can therefore not be applied for GMDSS purposes. For an introduction of VDES into the GMDSS, such as dissemination of MSI, modifications of the ITU, IMO, WMO and IHO instruments are required.

Noting the intervention from WMO and IHO during NCSR 10 the implication of the introduction of the VDE-TER as a MSI-Service needs to be very carefully evaluated, especially in respect of benefit versus cost.

Within ITU-R the listing any of these frequencies that needed GMDSS designation in the ITU RR Appendix 15 would require an Agenda Item at a WRC. This would require world-wide agreement that these frequencies would, at least in coastal regions, solely be dedicated to the maritime mobile service; taking into account that the ITU RR Appendix 18 channels are generally used also in other mobile services e.g. the land mobile service.

1. VDE-SAT

Currently, there is no IMO instrument to regulate or provide guidance on the use of VDE-SAT. Therefore, such IMO instrument should be developed when VDE-SAT or VDES as a whole is introduced in SOLAS.

The VDE-SAT frequencies are allocated in the ITU RR Article 5 and in the ITU RR Appendix 18 on a secondary allocation.

Without a primary allocation, a listing in the ITU RR Appendix 15 and usage within the GMDSS is impossible. In respect to the VDE-SAT it has to be noted that the maritime community made two attempts to implement the VDE-SAT component into the RR. At the WRC 19 a secondary allocation has been achieved in the ITU RR Article 5. At this time, it can be assumed it is unlikely that a new attempt will have a different result.

1. Operational analysis

VDES has been developed with the principle aim of facilitating the implementation of e-navigation through the digital exchange of data for maritime services. However, the regulatory analysis reveals that VDES currently does not meet the criteria for qualification as GMDSS equipment. Consequently, a thorough deliberation is necessary regarding the potential use of VDES and what steps are necessary to support GMDSS operations, particularly concerning the dissemination of safety-related information.

1. AIS

The operational aspects of AIS are already covered by several IMO instruments, encompassing shipborne stations, shore-based stations, aids to navigation (AIS-AtoN) and Search and Rescue locating device (AIS-SART, EPIRB-AIS [or MOB devices]). For the AIS which is one of the communication components of VDES, the same instruments are applicable as those which are in place for standard AIS.

1. ASM

The IMO document SN.1/Circ.289 is providing guidance on use for 22 AIS-ASMs, which are in international voluntary use. At this time, it is important to note that IMO does not mandate a specific set of ASMs for onboard use. These AIS-ASMs convey navigation-related information such as VTS-generated/synthetic targets or hydrographic/meteorological data and also data related to port operations such as clearance time to enter port and berthing data are defined messages. It is envisaged that these AIS-ASMs will be migrated to the ASM component of VDES to prevent excessive load on the AIS VHF Data Link (VDL) but it needs a careful transitional plan by IMO. Apart from AIS-ASMs, the AMS component of VDES can also facilitate the exchange of additional data content as determined by the application. The current IMO guidance on the use of AIS-ASM focuses on maintaining the integrity of the AIS VDL and safeguarding the core AIS functions. Naturally, it does not take into consideration the additional capacity and enhanced functionality offered by the ASM component. As MSC 103 mandated to implement VDES unto SOLAS for certain ships, there is a need to develop new documentation to provide mariners and shore authorities fully utilize the advantages of introducing the ASM component. Therefore, it is suggested to define a set of messages, mandated by IMO to be implemented on certain navigation equipment for presentation.

1. VDE-TER

The VDE-TER component enables direct exchange between ships, ships and shore stations [, ships and AtoN/off shore station]. As MSC 103 mandated NCSR to develop for VDES an amendment to SOLAS for certain ships, there is a need to develop new [mandatory] documentation for the use of VDE-TER.

1. VDE-SAT

The VDE-SAT component enables similar service to VDE-TER but by satellite, with the service provided by a satellite service provider. As MSC 103 mandated NCSR to develop for VDES an amendment to SOLAS for certain ships, there is a need to develop new [mandatory] documentation for the use of VDE-SAT or provision of satellite services. Due to the secondary allocation of VDE-SAT, the applications to be used are to be carefully evaluated.

1. User interface

A shipborne AIS installation includes a minimum display and keyboard. In addition, AIS has an appropriate interface according to IEC 61162 series for connection to external displays such as radar, ECDIS and INS. The minimum display mandated for AIS provides at least three lines of data consisting of bearing, range and name of a selected ship. It has to be questioned if such a display can be identified as sufficient for the usage of ASM, VDE-TER and VDE-SAT given a demand of the date being transmitted and received, for presentation and interpretation by the user. While VDES is not currently required to have this minimal keyboard display, it could incorporate a suitable interface to connect to the external displays. Therefore, there is a need to revise or amend other IMO instruments related to the display of information delivered by VDES considering the need for a mandatory connection between VDES and other systems onboard such as radar and ECDIS, when installed. It should be noted that S-100 Universal Hydrographic Data Model developed by IHO contains portrayal could contribute to the improvement of the user interface.

1. Human elements

Certain issues have been identified with AIS in SAR situations, notably language barriers and restricted means of information exchange. VDES holds the potential to alleviate these issues. With the potential introduction of VDES into SOLAS, there is a need to review, amend or develop IMO instruments related to human elements. This encompasses revising STCW Section A-II/1 and the AIS model course. The need for presentation of information received via VDES is immanent for the user, therefore an appropriate means for presentation and interpretation has to be specified for such information. Moreover, given that shore authorities will be furnishing a significant amount of information through VDES, it is important to address guidance for shore-side operations, including consideration for the training of shore-side operators.

1. Financial implications

Data exchange via AIS, ASM and VDE-TER is generally free for the ship installation at point of use, with expenses limited to VDES equipment procurement, installation and maintenance but the financial implication for service providers needs to be considered. The cost of procurement, installation, service delivery and maintenance for the coastal State could be significant and needs to be considered. In addition, there is no defined MSI system within GMDSS requiring VHF dissemination systems. If there were any requirements to provide this service, the above cost would be in addition to the already established infrastructure. Furthermore VDE-SAT communication might incur costs akin to other satellite communication services. VDE-TER and VDE-SAT also have the potential for value-added services to be offered at an expense to the ship-owners. As this decision has been taken by MSC 103 (see 18.10-18.13 of MSC 103/21), when VDES becomes mandatory, the relevance of cost implications is questionable. As there is a discussion on cost issues related to the recognized mobile satellite services, the cost issue on VDE-SAT should be raised.

1. Others

The matter of security, including cyber security, should also be taken into consideration, especially the vulnerabilities observed in AIS.

1. Conclusion

The AIS is the core component of VDES. The AIS is technically identical with the existing AIS and therefore it could serve be used as a substitute that required within SOLAS Chapter V. VDES encompasses additional components that functions as radiocommunication means, where MSC 103 has decided to regulate them under SOLAS, which may need to be regulated under SOLAS Chapter IV. A key concern regarding VDES as radiocommunication tool is that the channels of ASM and VDE-TER and the data transferred via these channels are not with in GMDSS and its satellite channels are allocated on a secondary basis. Should the IMO wish to introduce VDES in GMDSS for tasks such as MSI dissemination, the IMO Member States would have to request ITU a new Agenda item for a future consideration at WRC. Such an approach would also require modification within the IMO, WMO and IHO instruments. Other than GMDSS, VDES may serve for various communication needs which are to be identified. However, proper training is essential for seafarers and shore-side operators. As VDES only has a limited, if any, application-related display, it is important to identify navigation equipment such as radar, ECDIS etc. on IMO level as standardized means to present the different applications. Only by mandated and harmonized means for presentation and operation on ships from a certain time onwards, it would enable the maritime community that applications for e-navigation can be used by VDES efficiently by ships and shore side. For such a network connection with other navigation and communication equipment between shore side and vessels, it is essential to consider sufficient means of cyber security.

Bibliography

* SOLAS Chapter IV and V
* IMO Resolution A.1106 (29)
* IMO Resolution MSC.74 (69)
* IMO SN.1/Circ.289
* IMO COMSAR.1/Circ.46
* ITU Radio Regulations, Volume 1 Chapter 2, Volume 2 Appendix 15 and 18
* Recommendation ITU-R M.1371-5
* Recommendation ITU-R M.2092-1
* IALA Guideline G1082
* IALA Guideline G1117

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ANNEX 3

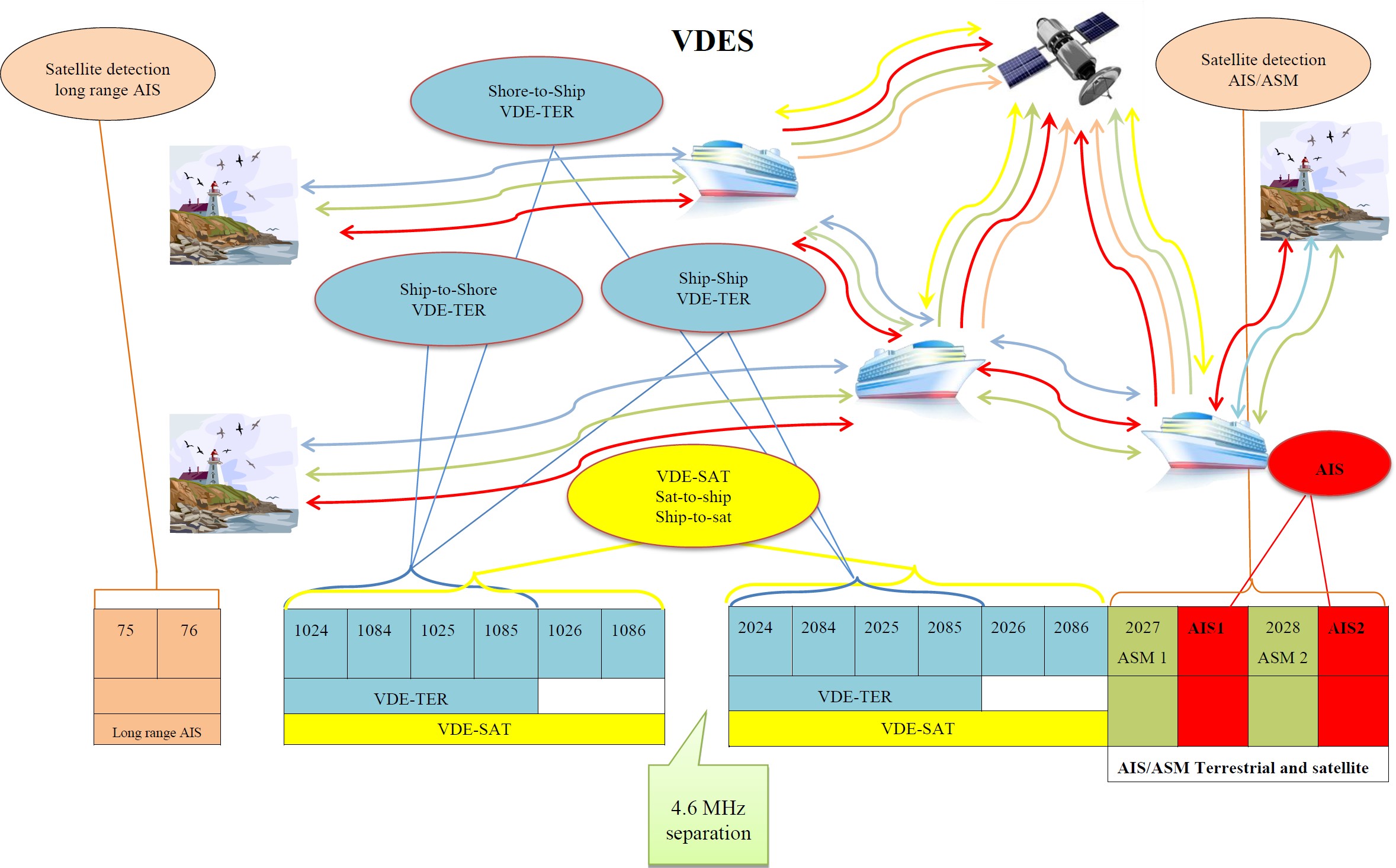
**DRAFT PERFORMANCE STANDARDS  
 FOR SHIPBORNE VHF DATA EXCHANGE SYSTEM (VDES)**

1. **Scope**
   1. These performance standards specify the requirements for the shipborne VHF Data Exchange System (VDES) for the use of VDES equipment from on-board vessels
   2. The VDES equipment integrates four communication components and their functions. These communication components are the automatic identification system (AIS) component, application specific message (ASM) component, terrestrial component of VHF data exchange (VDE-TER) and the satellite component of VHF data exchange (VDE-SAT).
   3. VDES should be capable of providing information exchange between ships, ships and shore authorities and services, automatically with minimal involvement of ship’s personnel and with a high level of availability and security[[2]](#footnote-2).
   4. VDES should be able to provide the following functions:
      1. a ship-to-ship mode for exchange data to improve safety, security and efficiency of navigation and protection of marine environment;
      2. as a means for coastal States to request and obtain information about a ship and its cargo and/or passengers;
      3. as a means for providing maritime services in the context of e-navigation; and
      4. provide means for standardized and automated reporting in accordance with MSC.1/Circ.1595[[3]](#footnote-3)
   5. The VDES should support 4 message priorities[[4]](#footnote-4) defined by SOLAS Chapter IV and the relevant article of the ITU-R RR.
   6. The installations, in addition to meeting the requirements of the ITU Radio Regulations, applicable ITU-R Recommendations and the general requirements set out in resolution A.694(17) and MSC.191(79) as amended should comply with these performance standards.

# Equipment Functionalities

* 1. The general functions of VDES equipment (see figure 1) are as follows:

1. VDES should have all four components;
2. AIS should not be interfered by other communication means within the VDES to provide AIS position reporting and safety-related information;
3. VDES should allow the flexibility to prioritize some applications and, consequently, adapt some parameters of the transmission (robustness or capacity) while minimizing system complexity;
4. VDES should give its transmission priority order as first AIS, second ASM, third VDE-TER and then to VDE-SAT;
5. The AIS component of VDES should be capable to provide those modes of operation as described in ITU-R M.1371, as amended;
6. VDES should be capable of exchanging data between ship-to-ship, ship-to-shore, shore-to-ship, ship-to-satellite and satellite-to-ship;
7. VDES should be capable of software/firmware updates;
8. VDES should be capable of separately disabling VDE-SAT, VDE-TER, ASM or AIS transmissions; and
9. VDES should be capable of changing its transmission power from default (12.5 W) to low (1 W) when an operation such as loading or discharging dangerous cargo requires it.



# Figure 1: VDES functions

* 1. The AIS component of VDES should comply with the requirements set out in resolution MSC.74(69), annex 3 and ITU-R M.1371, as amended.
  2. The ASM component of VDES should provide a robust and efficient terrestrial data transfer link enabling a wide variety of messages, including application specific messages currently transmitted by AIS. These messages should be coded in accordance with ITU-R. M.1371 Annex of “*Application specific messages*” and of “*Automatic identification messages”* and ITU-R M.2092 Annex of “*Common technical elements of VHF data change system”* and the technical characteristics should meet ITU-R M.2092 Annex of “*Technical characteristics of the application specific message channels for the VHF data exchange system in the VHF maritime band”,* as they are amended.
  3. The VDE-TER function of VDES should provide an efficient terrestrial data transfer link enabling a wide variety of applications for the safety, security and efficiency of navigation, protection of marine environment and others related to the maritime community and the technical characteristics should meet ITU-R M.2092 Annex of “*Technical characteristics of VHF data exchange-terrestrial in the maritime mobile band”* as amended.
  4. The VDE-SAT function of VDES should provide an efficient satellite data transfer link enabling a wide variety of applications for the safety, security and efficiency of navigation, protection of marine environment and others related to the maritime community and the technical characteristics should meet ITU-R M.2092 Annex of “*Technical characteristics of VHF data exchange-satellite operating in the VHF maritime mobile satellite band”* as amended.

# Capability

* 1. VDES should have one multi-channel transmitter and receiver capable of simultaneously supporting the functions of AIS, ASM, VDE-TER and VDE-SAT specified in this performance standard in addition to the components specified in resolution MSC.74(69), annex 3, as amended.
  2. In addition, VDES should be capable of:

1. automatically selecting an appropriate communication component in accordance with the link identification[[5]](#footnote-5) as well as directed by the shore authority;
2. receiving and demodulating digital data and output through the interface;
3. modulating and transmitting digital data inputted from the interface;
4. operating in various modes of operation, including the autonomous, assigned and polled modes; and
5. operating continuously while underway, moored or at anchor.

# Presentation interface

1. VDES should have at least minimum display and keyboard[[6]](#footnote-6) which may be implemented by another device.
2. To enable a user to input, access, select, output and display of the information on a separate system, VDES should provide at least one interface conforming to an appropriate international marine interface standard.
3. VDES should provide an interface for bridge alert management (BAM) in accordance with resolution MSC.302(82) on Performance standards for bridge alert management.

# Identification

* 1. All VDES stations should be uniquely identified with a unique numerical identifier as defined by the following:

1. a unique identifier as defined by the most recent version of Recommendation ITU-R M.585 on *Assignment and use of identities in the maritime mobile services*: and
2. if the unique identifier has a range which is greater than 999999999, then this number is in free form.

# Information

* 1. VDES communication consist of AIS information, safety/security-related information and other information
  2. AIS information is defined by resolution MSC.74(69), annex 3, as amended and should be exchanged by the AIS component of VDES.
  3. Safety/security-related information is provided by a competent authority or a ship and should be exchanged by ASM or VDE (both terrestrial and satellite) component of VDES.
  4. Other information is information other than AIS and safety/security-related information, and should be exchanged by ASM or VDE (both terrestrial and satellite) component of VDES (see IMO Guidelines for the use of VDES).
  5. Safety/security information sent by VDE (both terrestrial and satellite) component should be prioritized over other information.

# [System capabilities

VDES Installations, comprising the VDES-equipment and the associated equipment for processing and presentation of the information received via VDES should be capable of processing and presenting the following:

* AIS messages….
* ASM messages as listed in Circ…. Based on those described in SN.1/Circ.289, as amended and the regionally registered by authorities or International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) for the safety, security and efficiency of navigation, protection of marine environment and others related to the maritime community.
* VDE Messages as listed in Circ…. ]

# Cyber security

Since VDES is networked with other navigational/communication equipment or system on board, appropriate cyber security measures conforming to international standards such as IEC 61162-460 and IEC 63154 should be provided.

# Permissible time to be operational

The system should be operational within two minutes after being switched on by the user.

# Power supply

VDES and associated equipment should be powered by the ship’s main source of electrical energy. In addition, it should be possible to operate VDES and associated equipment from an alternative source of electrical energy.

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ANNEX 4

**Draft Guidelines for the operational use of  
 shipborne VHF Data Exchange Sysytem (VDES)**

**Purpose**

1. These guidelines have been developed for the safe and effective use of shipborne VHF Data Exchange System (VDES), in particular to inform the mariner and shore [stakeholders/station operators] about the operational use, limits and potential use of VDES including the international sharing of VDES applications. Consequently, VDES should be operated taking into consideration these guidelines.
2. VDES has four communication components comprising of Automatic Identification System (AIS), Application Specific Messages (ASM), VHF Data Exchange terrestrial (VDE-TER) and VHF Data Exchange satellite (VDE-SAT).
3. The AIS component of VDES is equivalent with AIS as defined in SOLAS regulation V/19 and should [include a MKD that is]be operated and used in accordance with the Resolution A.1106 (29) *Revised guidelines for the onboard operational use of shipborne automatic identification systems (AIS),* as amended. However, since VDES does not have the minimum display defined in the Resolution A.1106 (29) as amended, the data received or sent by the AIS component of VDES should be displayed on any suitable display as defined in paragraph 12 connected to the VDES.
4. Although VDES is capable of transmitting and receiving digital data on safety/security related information, the frequencies allocated for VDES are not frequencies used for GMDSS distress and safety communication that are protected by ITU-R Radio Regulations Appendix 15 and various articles of the Radio Regulations. Therefore, the user should not consider the data and information received by VDES as GMDSS information.
5. VDES itself is a radiocommunication equipment and exchanges digital data between [other VDES/VDES stations/VDES or AIS onboard other vessels]. VDES equipment should be connected with other navigational equipment or systems such as radar, ECDIS, INS and may be connected to other equipment such as onboard computer in order to work as whole communication system. Therefore, these guidelines aim at users, operators and stakeholders of VDES both onboard and ashore for providing guidance to ensure the safe and efficient operational use of VDES as a whole communication system.
6. AIS is a stand alone system which is also a component of VDES, however the other components of VDES do not have the same status under SOLAS V/19 as the other VDES components, ASM, VDE terrestrial and VDE satellite.

**Objective of VDES**

1. VDES is intended to enhance safety of life at sea, the safety and efficiency of navigation and the protection of marine environment by means of exchange of data between maritime stations, ship-to-ship, ship-to-shore, shore-to ship, ship-to-satellite and satellite-to-ship. SOLAS regulation IV/4 requires that ship is capable of transmitting and receiving general communications and SOLAS regulation V/19 requires that AIS exchanges data ship to ship and with shore-based facilities. Therefore, the purpose of VDES is to exchange digital data between ship to ship, ship to shore directly or via satellite in addition to the purpose of AIS. The digital data exchanged by VDES should be processed using applications installed in other equipment or system connected to VDES and portrayed on appropriate displays such as ECDIS.

**Description of VDES**

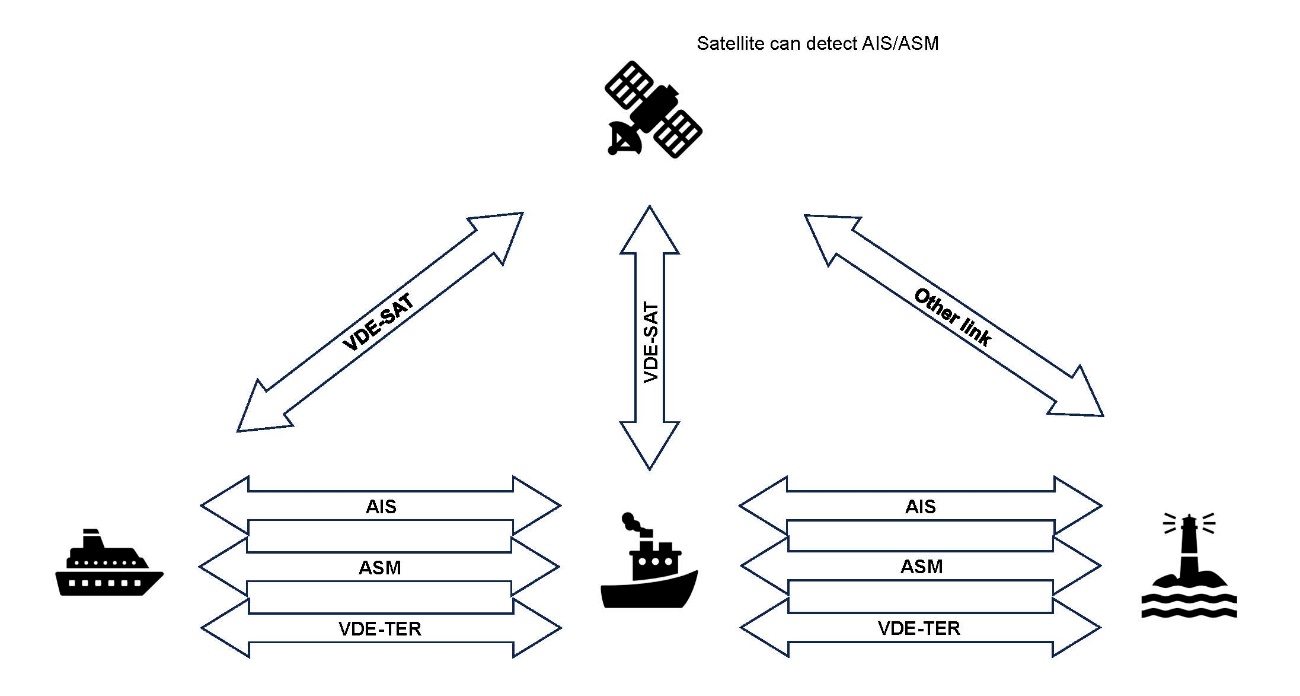


Figure 1 – VDES overview

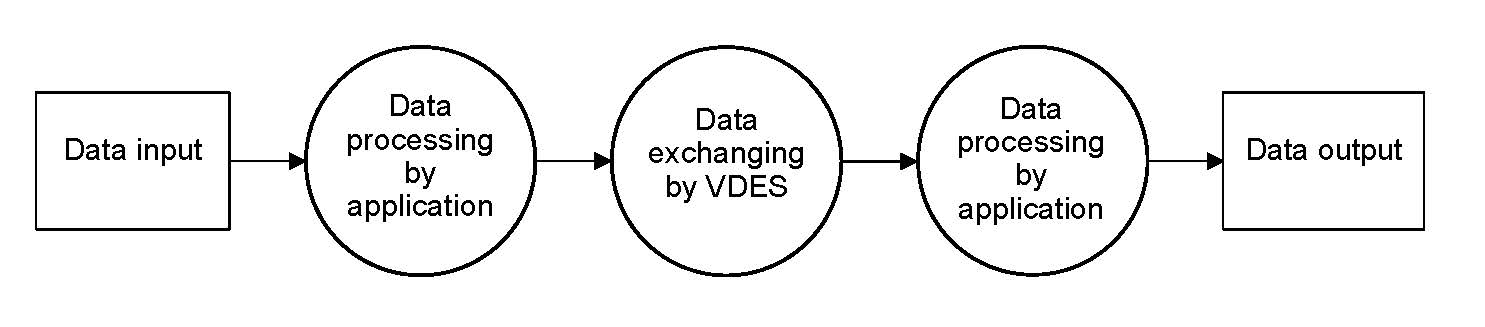


Figure 2 – Data flow using VDES

1. VDES can exchange digital data by automatically selecting one of its four communication components between ship and ship, ship and shore and ship and satellite (see Figure 1). The data exchanged by VDES will be processed by application installed in the external equipment or system for human-to-machine or machine-to-machine communication (See Figure 2).
2. VDES should give the highest priority to the AIS position reporting and safety related information
3. VDES generally achieves higher data transmission rates than AIS by employing wider bandwidths and advanced modulation methods. In a 100kHz channel, VDE-TER, specifically, achieves a maximum raw data rate up to 32 times greater than AIS.
4. VDES is able to communicate with other VDES stations within VHF range. However, when advanced modulation methods are used, the range may be reduced. In addition, when the transmission power of shipborne VDES is set to low (1 W) due to a safety reasons such as operation in port and harbors, the range may also be reduced.
5. The VDE-SAT has the potential to offer global coverage, contingent on satellite orbits and the number of satellites deployed and earth/ground stations. If VDE-SAT is used, then interference to terrestrial signals needs to be considered in relation to the service area of the VDE-SAT.

**Operational use of VDES**

1. The use of VDES is implemented by the operation of the external equipment or system using its applications. Therefore, the ship’s crew should be familiarized with itu operation of the equipment or system in accordance with the regulation I/14 of STCW and ISM code. In addition, the shore side users should be familiarized with its operation through education and training of the equipment or system. [Certain controls and buttons within the candidate system that will provide an operational interface for VDES may need to be standardized as VDES operation keys or buttons.]

**Human machine interface**

1. When a display presenting navigational information is connected to VDES, the display of navigation-related data should comply with the performance standards set out in Resolution MSC.191(79) *Performance standards for the presentation of navigational information on shipborne navigation displays,* as amended and the interim guidelines set out in MSC.1/Circ.1593 *Interim guidelines for the harmonized display of navigation information received via communication equipment*. As defined in Resolution MSC.191(79) as amended, the symbols used in the display are defined in SN.1/Circ.243 G*uidelines for the presentation of navigation-related symbols, terms and abbreviations,* as revised, or other relevant international standards[[7]](#footnote-7), therefore, the user should be familiarized with these symbols.

**Messages and applications**

1. Messages exchanged through VDES are AIS messages defined in the most recent version of the Recommendation ITU-R M.1371, ASM messages defined in SN.1/Circ.289 *Guidance on the use of AIS application-specific messages,* as revised, or regionally or locally registered by authorities or the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) and other messages [authorized/approved/registered] by authorities.
2. In order to ensure the world-wide harmonized implementation of message exchange by VDES, these messages should be [authorized/approved/registered] by authority and the authority is encouraged to share the message with its associated application to other authorities through international sharing mechanism such as Global Integrated Shipping Information System (GISIS) maintained by the Organization.
3. When a message is related to Maritime Services in the context of e-navigation listed in MSC.1/Circ.1595 *E-navigation strategy implementation plan – update 1*, the authority is encouraged to contact the domain coordinating body before submitting to the Organization for the coordination with other similar messages in order to avoid the duplication of similar messages.
4. Applications to the messages should be developed in accordance with the guideline defined in MSC.1/Circ. 1512 *Guideline on software quality assurance and human-centered design for e-navigation*.

**Cybersecurity**

1. In order to ensure the appropriate cyber risk management on VDES, the user should understand and comply with the guidelines set out in MSC-FAL.1/Circ. 3 *Guidelines on maritime cyber risk management*.
2. In order to secure communication through VDES, it is recommended to use service interfaces including information security protection[[8]](#footnote-8).

**Reference documents**

TBD

1. . [↑](#footnote-ref-1)
2. High level of security can be achieved by adopting security method such as encryption and/or authentication of data. [↑](#footnote-ref-2)
3. MSC.1/Circ.1595 *e-navigation strategy implementation plan – update 1* [↑](#footnote-ref-3)
4. the priorities Distress, Urgency and Safety can only be used when the related VDES frequencies/channels are referenced in ITU-R RR App.15 [↑](#footnote-ref-4)
5. The link identification is defined in Annex 1, ITU-R M.2092 as amended. [↑](#footnote-ref-5)
6. Refer to Resolution A.1106 (29) *Revised guidelines for the onboard operational use of shipborne automatic identification systems (AIS)* [↑](#footnote-ref-6)
7. IHO Publication S-52 - Specifications for Chart Content and Display Aspects of ECDIS and S-101 – Portrayal Catalogue (see appendix 1) and S-98 and IEC 62288/Ed.3 [↑](#footnote-ref-7)
8. IEC 63173-2 [↑](#footnote-ref-8)