

Agenda item 9 – IALA TECHNICAL ACTIVITIES

9.4 e-NAV

9.4.1 Documents submitted for approval

9.4.1-5 Draft Information Paper on the VHF Data Exchange System (VDES)

Note by the Secretariat

1 SUMMARY

VHF Data Exchange System (VDES) is a technological concept developed by the IALA e-NAV Committee and now widely discussed at ITU, IMO and other organizations. VDES was originally developed to address emerging indications of overload of VHF Data Link (VDL) of AIS and simultaneously enabling a wider seamless data exchange for e-navigation.

The IALA e-NAV Committee will continue its work on VDES in the coming four-year work period.

The purpose of this information paper is to inform the IALA Council and other IALA Committees of VDES, its purpose, plans and progress.

2 ACTION REQUESTED

The Council is requested to approve the information paper for circulation to CIRM, RTCM and IEC.

e-NAV14-17.1.3.1 v2	Information paper
Agenda item	10.3
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Author(s) / Submitter(s)	WG3 &4

Information Paper on VHF Data Exchange System (VDES)

3 ABSTRACT

VHF Data Exchange System (VDES) is a technological concept developed by the IALA e-NAV Committee and now widely discussed at ITU, IMO and other organizations. VDES was originally developed to address emerging indications of overload of the VHF Data Link (VDL) of AIS and simultaneously enabling a wider seamless data exchange for e-navigation, potentially supporting the modernization of GMDSS, both processes that are currently being developed by IMO. VDES is capable of facilitating numerous applications for safety and security of navigation, protection of the marine environment, efficiency of shipping and others. VDES will prospectively have a significant beneficial impact on maritime information services including Aids to Navigation and VTS in the future. IALA is ideally positioned to coordinate and harmonize the development and implementation of VDES, for the benefit of the whole maritime world.

1. PURPOSE

The purpose of this information paper is to inform IALA Council and other Committees of VDES, its purpose, plans and progress in order to consider this opportunity and better utilize it for their future work.

2. RATIONALE OF VDES

AIS is now well recognized and accepted as an important tool for safety of navigation and is a carriage requirement for SOLAS vessels (Class-A). However, because of its effective and useful technology, the use of AIS has expanded to vessels not compliant with the carriage requirement (Class-B) and other applications such as Aids to Navigation (AtoN), Application Specific Messages (ASM), Search and Rescue Transmitter (SART), Man Over-Board unit (MOB) and EPIRB-AIS. This expanding use of AIS technology has caused a significant increase in VHF Data Link (VDL) loading which has become an active concern in IMO and ITU.

Simultaneously, because of increasing demand of radio spectrum for digital communication such as mobile phone and data, ITU now requests more efficient and effective use of the radio spectrum. In 2009, ITU issued Recommendation ITU-R M.1842-1 "Characteristics of VHF radio systems and equipment for the exchange of data and electronic mail in the maritime mobile service RR Appendix 18 channels." This technique will provide higher data rates (up to 32X) than the present AIS and will become a core element of VDES. Furthermore VDES network protocol should be optimized for data communication so that each VDES message is transmitted with a

very high confidence of reception. Consequently VDES will allow more efficient and effective use of the marine VHF spectrum.

Considering this, the World Radio Conference of 2012 (WRC-12) adopted Resolution 360 [COM6/21] (WRC-12) “Consideration of regulatory provisions and spectrum allocation for enhanced Automatic Identification System technology applications and for enhanced maritime radiocommunication” and decided to discuss the matter at WRC-15 under agenda item 1.16.

According to IALA Recommendation A-124 Appendix 18 “VDL Loading Management”, if the VDL loading exceeds 50%, it may have an impact on the smooth transmission of AIS stations¹. The recent ITU-R WP5B meeting (May 2013) reported that VDL loading had already exceeded 64% in the Northern Gulf of Mexico, USA, and had also reached almost 40% in Korea and Japan. It is therefore urgently necessary to allocate new frequencies for new and emerging applications of AIS technology in order to mitigate overloading of the AIS VDL.

E-navigation is defined by IMO as “the harmonized collection, integration, exchange, presentation and analysis of marine information onboard and ashore by electronic means to enhance berth to berth navigation and related services for safety and security at sea and protection of the marine environment.” IMO is now developing an e-navigation strategy implementation plan with a target completion year for the plan of 2014. Simultaneously, IMO is now conducting a review and modernization of GMDSS with a target completion year of 2017. In the discussion of both matters, one of the common key elements is exchange of information and this will be achieved possibly by digital data exchange.

Digital data exchange can be achieved using a whole multitude of commercially available data links, however global availability and interoperability is an issue. Since VDES is an opportunity for a globally interoperable capability of significantly higher speed and larger volume data exchange than AIS or DSC, and potentially with world wide coverage, VDES can become one of the core facilitating elements for both the implementation of e-navigation and the modernization of GMDSS.

3. IMPACT ON IALA

As the second generally available maritime digital two-way radio communication system after AIS, VDES will make various impacts on IALA members as well as other maritime communities.

¹ However, even in this high slot usage situation, a mobile AIS station is designed to avoid losing a target that may pose a danger by using time slots of the most distant stations and therefore the most important function of AIS, i.e. ship to ship anti-collision functionality, is more robust.

At present, the AIS and communication Working Group of the e-NAV Committee of IALA is already drafting technical proposals for VDES, in liaison with ITU-R Working Party 5B, in necessity of protecting the existing AIS system. IALA needs through its liaison with IMO and IALA members to promote this opportunity for introducing VDES. IALA is expected to contribute to the ITU-R WP.5B meeting of May 2014, however the present IALA meeting schedule does not fully meet this requirement.

One of the impacts could be a migration of AIS ASM and all other related messages from AIS 1 and 2 channels to ASM 1 and 2 channels. The main rationale for the development of VDES is to avoid overloading of AIS VDL and hence to protect the AIS main function of safety of navigation. Thereby, AIS 1 and 2 channels will be solely allocated for navigational safety purposes. Other supplemental messages, i.e. ASM such as weather info, could be moved to ASM 1 and 2 channels. AtoN authorities now broadcasting ASM using AIS 1 and 2 channels could consider using the new frequencies, ASM 1& 2 and IALA could coordinate and provide technical assistance for the change.

Since VDES has higher speed and robust data exchange capability with the potential for worldwide coverage, there may be numerous benefits to AtoN services and VTS. Virtual AtoN could be deployed beyond a limit of VHF range such as the high seas, or remote/polar areas. VTS could exchange more comprehensive data with ships than the present AIS can provide. Machine readable digital data will enable a navigational display to portray navigational safety information graphically, assisting to overcome language barriers between VTS operators and mariners. AtoN authorities will be able to develop various applications for their use and make advanced services available to ships using VDES. IALA could coordinate and harmonize development and implementation of such applications.

However, just like new applications of AIS, e.g. class B AIS, AIS AtoN, ASM, AIS SART, AIS MOB, EPIRB-AIS and the multitude of international and regional ASMs, were rapidly and easily developed, generating a risk of overloading of the AIS VDL, new VDES applications will be developed easily and rapidly, not only by AtoN authorities, but also by other actors. There is a risk that such rapid expansion of VDES applications could cause confusion in the maritime society and the data links would quickly reach their capacity limits. Therefore, there will be need of an international body that will monitor, coordinate and control if necessary, the development and implementation of VDES applications. IALA is in a good position to undertake the task of monitoring, coordinating and harmonizing the evolving applications, while IMO is capable of imposing relevant control measures where needed.

4. ROAD MAP

It is anticipated that VDES may be implemented in two parts; terrestrial VDES and satellite VDES. Some radio manufacturers have already started to develop the prototype VDE transceiver that has the capability of the VHF digital data exchange (VDE) function which is defined by Recommendation ITU-R M.1842-1. Those

prototypes will be available to support testing in 2014. Although this VDE transceiver will have only limited capability of VDES, the core technology of the VDE transceiver will be incorporated into the first implementation of VDES. If WRC-15 approves the allocation of new frequencies for VDES, because of the present technical development and urgency of protection of AIS VDL, terrestrial VDES could be implemented first, even before satellite assets are available. At the present moment, the satellite VDES studies, for example, sharing study for land mobile stations of VHF, are underway in ITU. It is expected that such studies will be completed during the development of the ITU Recommendations for VDES so that final decisions by WRC-18 can facilitate a fully featured VDES including the satellite aspects. Figure 1 provides a possible roadmap for VDES.

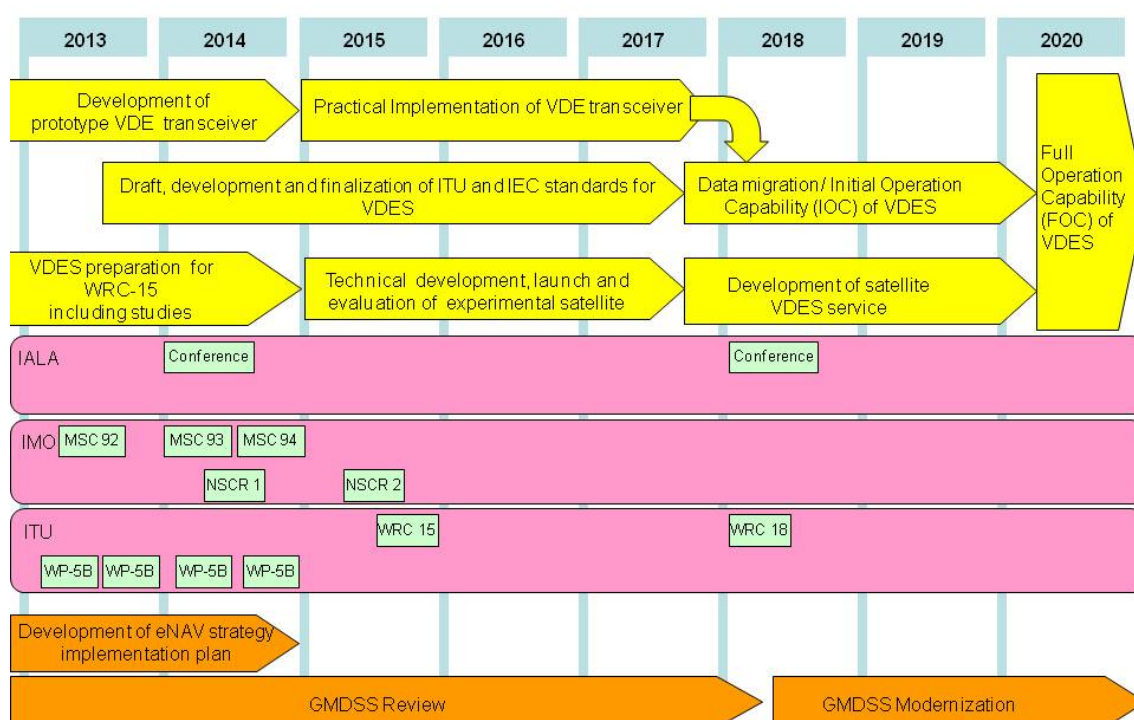


Figure 1: Possible Roadmap for VDES

5. TECHNICAL FEATURES

The IALA e-NAV Committee and ITU-R WP5B have developed the concept of VDES. The VDES integrates the function of AIS, ASM and VDE and includes the channels for these functions with satellite transmission and reception. A proposed arrangement of the globally available channels and usage is shown in Table 1. Further studies and testing will be required for a final arrangement of the channels.

TABLE 1
Example channel designations
Appendix 18 channels and frequencies for the VHF data exchange system (AIS, ASM
and VDE)

Channel number in RR Appendix 18	Transmitting frequencies (MHz) for ship and coast stations	
	Ship stations (ship-to-shore) (long range AIS) Ship stations (ship-to-satellite)	Coast stations Ship stations (ship-to-ship) Satellite-to-ship
AIS 1	161.975	161.975
AIS 2	162.025	162.025
75 (long range AIS)	156.775 (ships are Tx only)	N/A
76 (long range AIS)	156.825 (ships are Tx only)	N/A
2027 (ASM 1)	161.950 (2027)	161.950 (2027)
2028 (ASM 2)	162.000 (2028)	162.000 (2028)
24/84/25/85 (VDE 1)	100 kHz channel (24/84/25/85, lower legs, merged) Ship to shore Ship to satellite	100 kHz channel (24/84/25/85, upper legs, merged) Ship to ship, Shore to ship Satellite to ship under certain conditions
24	157.200 (1024)	161.800 (2024)
84	157.225 (1084)	161.825 (2084)
25	157.250 (1025)	161.850 (2025)
85	157.275 (1085)	161.875 (2085)
26/86 (SAT 1)	50 kHz channel (26/86, lower legs, merged) Ship to satellite	50 kHz channel (26/86, upper legs, merged) Satellite to ship
26	157.300 (1026)	161.900 (2026)
86	157.325 (1086)	161.925 (2086)

6. FUNCTIONALITIES

Since VDES is designed for higher data exchange capability than AIS with worldwide coverage, various functionalities can be considered. The radio links enabled by robust VDES and their use by ships, shore stations and satellites are illustrated pictorially in Figure 2.

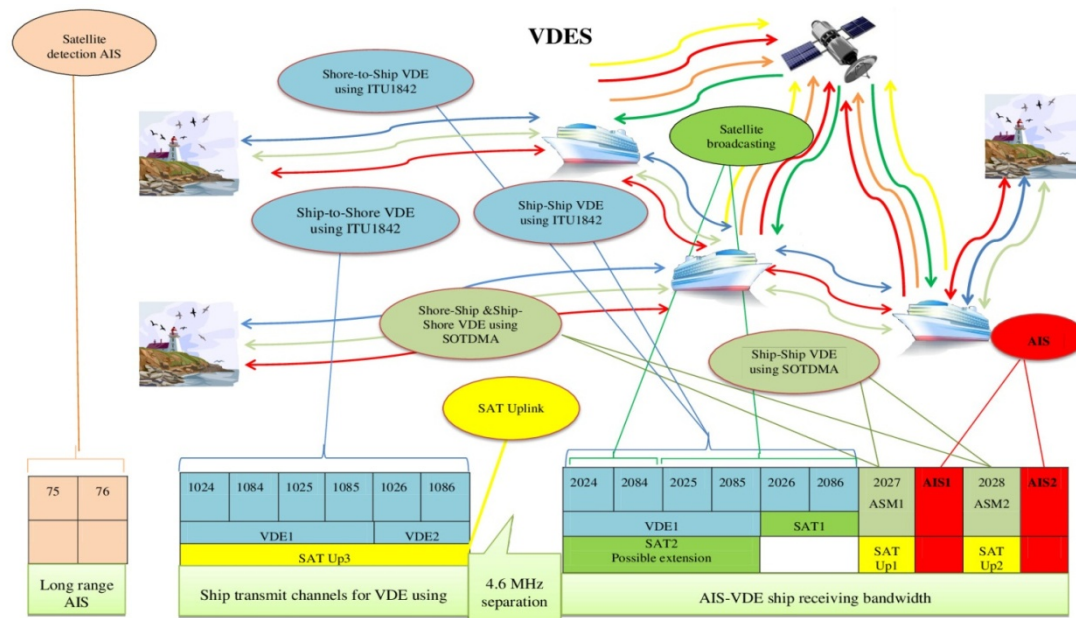


Figure 2: VDES radio links

Table 2 provides a summary of the proposed technical assignment of various VHF channels for communication including protocol and types of messages to meet the functionality required by user needs.

Table 2
VDES Communications including AIS, ASM and VDE

Channel number in RR Appendix 18	Transmitting frequencies (MHz) for ship and coast stations	
	Ship stations (ship-to-shore) (long range AIS) Ship stations (ship-to-satellite)	Coast stations Ship stations (ship-to-ship) Satellite-to-ship
AIS 1	161.975	161.975
AIS 2	162.025	162.025
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76 (long range AIS)	156.825 (ships are Tx only)	N/A
2027 (ASM 1)	161.950 (2027)	161.950 (2027)
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Channel number in RR Appendix 18	Transmitting frequencies (MHz) for ship and coast stations	
	Ship stations (ship-to-shore) (long range AIS) Ship stations (ship-to-satellite)	Coast stations Ship stations (ship-to-ship) Satellite-to-ship
24/84/25/85 (VDE 1)	25/100 kHz channel (24/84/25/85, lower legs, merged) Ship to shore Ship to satellite	25/100 kHz channel (24/84/25/85, upper legs, merged) Ship to ship, Shore to ship Satellite to ship under certain conditions
24	157.200 (1024)	161.800 (2024)
84	157.225 (1084)	161.825 (2084)
25	157.250 (1025)	161.850 (2025)
85	157.275 (1085)	161.875 (2085)
26/86 (SAT 1/VDE 2)	25/50 kHz channel (26/86, lower legs, merged) Ship to satellite/shore	25/50 kHz channel (26/86, upper legs, merged) Satellite/shore to ship
26	157.300 (1026)	161.900 (2026)
86	157.325 (1086)	161.925 (2086)

7. CONCLUSIONS

Just as the internet has changed the world drastically, e-navigation will have a significant impact on the maritime community, and VDES may be the globally interoperable key to the introduction of e-navigation. Its capability of higher speed digital data exchange with potential for world wide coverage may pave the way for implementation of e-navigation and modernization of GMDSS. However, just as the internet has not only had good effects but also adverse side-effects, the development and implementation of VDES must be undertaken with great caution, or it is at risk of causing confusion and jeopardizing the safety of navigation. IALA is ideally positioned to coordinate and harmonize the development and implementation of VDES, just like IALA did with AIS, in cooperation with other international organizations, for the benefit of the whole maritime world.