



Deliverable D1.12

Report on Review of IALA documentation related to VHF Data Exchange System

Project no. 636329
Project acronym: EfficienSea2
EFFICIENSEA2 – efficient, safe and sustainable traffic at sea

Funding scheme: Innovation Action (IA)
Start date of project: 1 May 2015
End date of project: 30 April 2018
Duration: 36 months

Due date of deliverable: 01.05.2017
Actual submission date: 05.02.2017

Organisation in charge of deliverable: IALA



1. DOCUMENT STATUS

1.1. Authors

Name	Organisation
J Carson-Jackson	IALA

1.2. Document History

Version	Date	Initials	Description
Vs 1	27/02/2017	JACJ	Initial document for review
Vs 2	25/04/2017	JACJ	Revised following input from IALA ENAV Committee
Vs 3	07/07/2017	JACJ	Revised following input from IALA Committees
Vs4	06/03/2018	SD	Format review

1.3. Review

Name	Organisation
Bjorn Pedersen	DMA
Michael Card	IALA

2. Contents

1. DOCUMENT STATUS.....	2
1.1. Authors	2
1.2. Document History.....	2
1.3. Review.....	2
2. Contents	3
1. Introduction	5
2. Document	5
3. General comments.....	5
4. VDES sample text for IALA Recommendations	6
5. VDES sample text for IALA Guidelines.....	14
5.1. Draft text for Guidelines	14
5.1.1. General overview, links to e-Navigation	14
5.1.2. Anticipated use of VDES.....	14
5.1.3. Outcomes of WRC-2015 VDES.....	16
5.1.4. Frequency allocation.....	16
5.1.5. VDES shore infrastructure	18
5.1.6. VDES and Aids to Navigation	18
6. Non-IALA Documents	31
7. Appendix A – Proposed documentation structure for VDES and related documents	37
7.1. Introduction	37
7.2. MBSE concept applied to VDES documentation	38
7.3. MBSE process description.....	39
7.4. Adopting MBSE in IALA Documentation	41
8. References	41

List of tables

Table 1 – IALA Recommendations related to the introduction of VDES.....	7
Table 2 Example of anticipated VDES communications including AIS, ASM, and VDE	15
Table 3 presents the channel allocation of VDES	17
Table 4 – IALA Guidelines related to the introduction of VDES.....	19
Table 5 Non-IALA documents related to VDES.....	31
Table 6 Table Use of MBSE in IALA documentation	41

List of figures

Figure 1 VDES functions and frequency use – full system 16

Figure 2 VDES functions and frequency use..... 17

Figure 3 Systems Engineering (SE) Domain 37

Figure 4 Visual representation of PMTE..... 38

Figure 5 Concept of complexity vs time..... 39

Figure 6 – ‘W’ design for MBSE 40



1. Introduction

In WP1 of EfficienSea 2, IALA leads Task 1.3: Coordinating standardization of solutions. IALA manages the work In Task 1.3, preparing reports and deliverables in conjunction with the other members of the Task Group (CIRM, UKHO).

2. Document

This document provides a general overview and detailed review of the IALA documentation that may require amended to refer to, or include, VHF Data Exchange System (VDES).

A high-level overview of IMO and ITU documents has also been carried out.

IHO, IEC and ISO documents have not been reviewed.

This document includes comments received from a review by IALA Committees. It is noted that the overall review and revision of IALA documents will be included as part of the upcoming 4-year work cycle, where appropriate.

3. General comments

- When an IALA document is ‘withdrawn’ or ‘archived’, it is recommended that a reference is made on the website to the document, with indication of status (e.g archived, withdrawn) and date the document was removed.
- To facilitate review of historic documents, it is suggested to develop an ‘archive’ document area on the website, with a suitable disclaimer regarding the status of the documents found on the site. All documents posted to the archive area should be clearly marked as such.
- When an IALA document is superseded by another document or has been merged in a new document, it is recommended that a reference is made on the website to the document, with indication that the document has been superseded / combined with another document, indication (with hotlink) of the new document, and the date this was done.
- Where documents are related – such as V-128 and associated guidelines, recommend including the reference on the website, with hot links, and, if possible, providing a ‘grouped’ reference with notification on the left-hand panel. Reference to the appropriate guideline(s) / recommendation(s) should also be included in the document revisions section.
- Update the VTS training link on the left-hand panel to include a landing page with all related VTS training documents.

For a general introduction / overview of VDES in the short term, suggestion to develop an overarching, ‘bridging’ document that provides general information on VDES; references VDES Overview Guideline and notes the various recommendations and guidelines that are affected by the fact that AIS is part of VDES. This would be appropriate for each item identified for update ‘short term’ then the ‘mid-term / longer term’ approaches can provide more detail, be based on the latest developments in VDES as the time of revision.

Note 1 - Document colour references – white (no colour) – amendment required; salmon – archived or recommended to be archived; green – no amendment required; orange – need to monitor, amendment may be required.

Note 2 - IHO, IEC and ISO documents not reviewed at this time.

4. VDES sample text for IALA Recommendations

Generic text for the IALA Recommendations noted in Table 1 is provided. This generic text would require modification to fit with specific recommendations. The approach necessitates a review of the recommendation text and the addition of suitable generic statements. Possible additional text requirements are noted in the table.

RECOGNISING FURTHER that the International Telecommunications Union (ITU), at the World Radio Conference 2015, approved a standard for the VHF Data Exchange System (VDES), Recommendation ITU-R M.2092-0.

NOTING FURTHER that IALA has developed Guideline 1117 - an Overview of VDES and Recommendation R1007 on the Introduction of VDES.

RECOMMENDS FURTHER that National Members and other appropriate authorities providing aids to navigation services note the developments of VDES and the implications for provision of *[AIS and VDES shore based services] [VTS]...*



Table 1 – IALA Recommendations related to the introduction of VDES

Doc Type / Number	Doc Name	Key points	Amendment Required?	Suggested timing for amendment	Priority – H, M, L
IALA Documents ¹ - Recommendations					
A-123 Ed.2 - June 2007	Provision of shore based AIS	Highlights the requirement for members to establish AIS shore stations to respond to the SOLAS Chapter V, Reg. 19 (2.4) indication that AIS ship units can exchange information with the shore.	Yes – review required in general (old document); reflect VDES base station. Do minor update now / put in transition framework for more details as VDES BS develop.	Initial revision - 2018 Further revision 2020 (post ITU WRC2019) Absorb into future development of combined AIS/VDES recommendation	H
A-124 Ed. 2.1 (base document) - December 2012	Networking aspects of AIS (main document)	Indicates technical elements of networking AIS shore stations as part of an AIS service. Series of appendixes refer.	Yes – for immediate time, update to ref VDES; put in transition framework for more details as VDES develops further. Suggest general overhaul of the A-124 series to be more streamlined and reduce extraneous references to appendixes that have never been developed / are unnecessary.	Initial revision - 2018 Include in more general review of A-124 (including review of current documentation structure) 2020+	H
A-124 Appendix 0 Ed 1 - December 2012	References, Glossary of Terms and Abbreviations	As indicated	Yes – add in VDES definition now; put in transition framework for additional definitions in future. More general – verify how this fits with IALA Dictionary – consider discontinuing if details fit in Dictionary.	Initial revision - 2018 Include in more general review of A-124 (including review of current documentation structure) 2020+	H

¹ Additional IALA documentation available includes Manuals, IALA dictionary and proceedings from VTS Symposiums and IALA conferences.

Doc Type / Number	Doc Name	Key points	Amendment Required?	Suggested timing for amendment	Priority – H, M, L
A-124 Appendix 1 Ed 1 - December 2011	Basic AIS Services	Presents the basic aspects of AIS as a defined set of items – supports interaction between the AIS and other shore-based technical services / links to the IALA Common Shore-Based System Architecture (CSSA).	Yes – add in overview para of VDES now; put in transition framework for more complete revision as VDES develops.	Initial revision - 2018 Include in more general review of A-124 (including review of current documentation structure) 2020+	H
A-124 Appendix 4 Ed 1 - December 2011	Interaction and data flow model of the AIS Service	Looks at the AIS aspects within overall data flow considerations.	Yes – add in overview para of VDES now; put in transition framework for more complete revision as VDES develops. Data flow more generally within the digital radio context (including VDES, which includes AIS) will need further review and development.	Initial revision - 2018 Include in more general review of A-124 (including review of current documentation structure) 2020+	H
A-124 Appendix 5 Ed 1 - December 2011	Interfacing model of the AIS Service	Identifies all interface points of the AIS Service, both M2M and HMI elements.	Yes – add in overview para of VDES now; put in transition framework for more complete revision as VDES develops. Interface points more generally within the digital radio context (including VDES, which includes AIS) will need further review. Note – how does this fit with CSSA developments?	Initial revision - 2018 Include in more general review of A-124 (including review of current documentation structure) 2020+	H
A-124 Appendix 9,10 & 11 Ed 1 - December 2012	Functional Description of the AIS Service Components	Core document for the functional description of AIS.	Yes - add in overview para of VDES now; put in transition framework for more complete revision as VDES develops.	Initial revision - 2018 Include in more general review of A-124 (including review	H



Doc Type / Number	Doc Name	Key points	Amendment Required?	Suggested timing for amendment	Priority – H, M, L
			Functional descriptions for all aspects will evolve in VDES. Confirm how this fits with use cases for VDES – functional description of VDES.	of current documentation structure) 2020+	
A-124 Appendix 12 Ed 1 - December 2012	Co-location issues at AIS Physical Shore Stations and on-site infrastructure considerations	Covers the possibility of an AIS-PSS being co-located with other AIS equipment, or with non-AIS equipment suites which may or may not utilize shared antennas and/or network connectivity.	Yes - add in overview para of VDES now; put in transition framework for more complete revision as VDES develops. VDES development is looking at options re co-location or equipment, antennae, etc.	Initial revision - 2018 Include in more general review of A-124 (including review of current documentation structure) 2020+	H
A-124 Appendix 14 – Ed 2 - December 2011	FATDMA Planning and Operation of an AIS Service	Provides information on why, and how, to do FATDMA planning.	Yes - add in overview para of VDES now; put in transition framework for more complete revision as VDES develops.	Initial revision - 2018 Include in more general review of A-124 (including review of current documentation structure) 2020+	M
A-124 Appendix 17 – Ed 1 - December 2011	Channel Management by an AIS Service	Provides information on channel management, noting that channel management is an activity that requires careful planning.	In essence, Yes – add in overview para of VDES now. However, noting the ongoing discussions re channel management, put into a transition framework to verify if required in the future.	Initial revision - 2018 Include in more general review of A-124 (including review of current documentation structure) 2020+	M

Doc Type / Number	Doc Name	Key points	Amendment Required?	Suggested timing for amendment	Priority – H, M, L
A-124 Appendix 18 – Ed 1 - December 2011	VDL Load Management	Presents considerations and best practices when conducting AIS VDL Load management.	Yes – update to reflect the input to ITU on AIS VDL load issues / impacts and add in section on VDES. This could be a new section 6 – coming after additional design considerations.	Initial revision - 2018 Include in more general review of A-124 (including review of current documentation structure) 2020+	H
A-124 Appendix 19 – Ed 1 - December 2011	Satellite AIS Considerations	Presents the concepts of Sat AIS reception.	Yes – add in overview para on VDES, noting specifically Sat aspects. Include section on ASM developments post WRC-2015 (sat reception). More general considerations re Sat aspect of VDES.	Initial revision - 2018 Include in more general review of A-124 (including review of current documentation structure) 2020+	H
A-126 – Ed. 1.5 – June 2011	Use of AIS in marine aids to navigation service	Notes opportunities for using AIS to assist in the provision of an AtoN service.	Yes – add in overview para on VDES, confirm outcomes of Korea workshop (Oct 2016)	Initial revision - 2018 Absorb into future development of combined AIS/VDES recommendation	M
V-103 ed2.1 - December 2013	Training and Certification of VTS Personnel	Includes a series of model course (V-103/1; V-103/2; V-103/3; V-103/4; and V-103/5)	V-103 Ed 2.1 – no		
			V-103/1 – Yes (where AIS referenced)	2019	M
			V-103/2 – no		
			V-103/3 – Yes (where AIS referenced)	2019	M

Doc Type / Number	Doc Name	Key points	Amendment Required?	Suggested timing for amendment	Priority – H, M, L
			V-103/4 – no		
			V-103/5 – Yes (where AIS referenced / include in table1)	2019	M
V-119 - December 2009	Implementation of VTS	Notes the issues and opportunities presented by implementing a VTS. Includes needs analysis and criteria for determining type of service.	No amendment required		
V-128 Ed. 4.0 - June 2015	Operational and technical performance requirements for VTS	References equipment that could be in place at a VTS, noting the expected performance of each. (References guideline 1111)	No amendment required for recommendation. Guideline to be amended.		
V-145 Ed 1 - June 2011	The Inter-VTS Exchange Format (IVEF) service	Presents IVEF as a common framework for the exchange of vessel traffic information / vessel traffic image between shore-based e-navigation system.	Yes – mid-term time frame (link to AIS Shore side update A-123; A-124 appendixes)	2020+	L
O-138 – Ed. 1- Dec 2007	The Use of GIS and Simulation by AtoN Authorities	Links to Reg 13 of SOLAS re AtoN and notes the benefits of GIS and simulation techniques in assisting AtoN authorities in assessing the requirement for, and provision of, AtoN.	Yes – add in overview para noting the link to AIS within the document. confirm outcomes of Korea workshop (Oct 2016)	2018	M
O-139 – Ed 2 – December 2013	Marking of man-made offshore structures	Identifies options to mark the increasing number of man-made structures as sea – including	Yes – confirm outcomes of Korean workshop (Oct. 2016)	2019	M

Doc Type / Number	Doc Name	Key points	Amendment Required?	Suggested timing for amendment	Priority – H, M, L
		those that may be isolated or in groups, and in various locations.			
O-143 – Ed 1.1 – May 2013	Provision of virtual AtoN	Recognises the value of virtual AtoN, as well as the issues and concerns. Also notes the need to display information. (Guideline 1081 refers).	Yes – confirm outcome from Korean workshop (Oct 2016)	2019	M
e-NAV-140 – Ed2 – May 2015	Architecture for shore-based infrastructure ‘fit for e-Navigation’	Notes the development of e-Navigation, and the work of other organisations including IMO and IHO. Specific reference to IHO’s Geo-spatial Information Registry (GI Registry). Recommendation on Service-Oriented Architecture and user-requirements driven system design. (related Guideline 1113 – also 1114, but not referenced in the document; need to confirm reference to 1114)	Not for the recommendation, but amendment for the related guidelines. Should look at link to CSSA / IVEF as well (Note there is a need to make the reference in the Recommendation - document change notes only ‘moved to a new guideline’)		
e-Nav-142 – Ed 1 – December 2009	Maritime Data Sharing ‘IALA-NET’	Recognises the development of vessel tracking technologies and capabilities and recommends that National Members participate in IALA-NET.	Yes – by short reference to VDES, noting AIS is part of VDES. Also, as VDES develops, requirement for / desire to share information is expected to grow.	Initial revision - 2018 Further revision 2020 (post ITU WRC2019)	L
e-Nav-144 – Ed 1 – June 2011	Harmonized implementation of application specific messages (ASM)	Refers to chapters V, Regulation 4, 10 and 13 of SOLAS as well as link to ITU. Highlights the need to harmonise ASMs and	Yes - confirm outcome from Korean workshop (Oct 2016)	2018	M

Doc Type / Number	Doc Name	Key points	Amendment Required?	Suggested timing for amendment	Priority – H, M, L
		notes that IALA holds a registry of ASMs.			
e-Nav-146 – Ed 1 – December 2011	Strategy for maintaining racon service capability	Notes the development of NT Radars; the changes in development of S-band radars (not to trigger Racons – IMO MSC Resolution 192(79); the potential role of AIS.	Yes – amend section 5.6 – non-radar technology. Could also include text in section 6 – strategy.	2018	M

5. VDES sample text for IALA Guidelines

Generic text for the IALA Guidelines noted in Table 4 is provided in the form of paragraphs that may be inserted as appropriate within the document, noting the need to tailor to each specific topic.

Where appropriate, a suitable link (in text or hot linked within the document) should be made to other IALA, ITU, IEC, E2 or other documentation on VDES (IALA Guideline 1117 VDES Overview; ITU-R M.290-0; E2 D.1.11 – Maritime Digital Communications Strategy; etc.)

Reference to tables or figures in this document has not been formatted, noting this will be done when the text is captured in the relevant IALA Guideline.

5.1. Draft text for Guidelines

5.1.1. General overview, links to e-Navigation

Maritime Communications Systems are evolving to embrace enhanced digital capabilities within the existing framework of maritime mobile spectrum allocations.

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.

Almost every e-Navigation solution currently foreseen depends upon efficient and robust ship-ship, ship-shore or shore-ship electronic data transfer. Existing communications systems may, in many places, be adequate to serve these needs, but it may be necessary to develop new methods to realise the full potential of e-Navigation. The performance requirements, in particular data capacity, for communications systems to support e-Navigation are, in many cases, unknown and are likely to change over time.

5.1.2. Anticipated use of VDES

Table 2 Example of anticipated VDES communications including AIS, ASM, and VDE provides an overview of the anticipated use for VDES as a complete system which includes AIS, ASM and VDE. IALA has published a Guideline that provides an overview of VDES, including more information on use-cases for VDES and the road map to develop and implement this system. [<http://www.iala-aism.org/product/vhd-data-exchange-system-vdes-overview-1117/>]

Table 2 Example of anticipated VDES communications including AIS, ASM, and VDE

	VHF Data Communications (including ASM and VDE)		AIS	
Sub-group	<u>Data communications for ASM</u>	<u>Data communications for VDE</u>	<u>AIS for safety of navigation</u>	<u>AIS long range</u>
Radio channels	<ul style="list-style-type: none"> Channels 27 and 28 World-wide dedicated channels (agreed at WRC-15) 	<ul style="list-style-type: none"> Channels 24, 84, 25, 85, 26, 86 for VDE (agreed at WRC-15) 	<ul style="list-style-type: none"> AIS-1 & AIS-2 (simplex) 	<ul style="list-style-type: none"> Channels 75 and 76 (simplex) (agreed at WRC-12)
Functionality	<ul style="list-style-type: none"> Marine safety information Marine security information SSRMs General purpose information communication 	<ul style="list-style-type: none"> General purpose data exchange Robust high speed data exchange VDE satellite uplink and downlink (to be confirmed WRC-19) 	<ul style="list-style-type: none"> Safety of navigation Maritime locating devices 	<ul style="list-style-type: none"> Satellite detection of AIS Possible support of future SAR
Message types	<ul style="list-style-type: none"> IMO SN.1/ Circ.289 international application specific messages Regional application specific messages Base Station 	<ul style="list-style-type: none"> To be defined 	<ul style="list-style-type: none"> Vessel identification Vessel dynamic data Vessel static data Voyage related data Aids to Navigation Base Station 	<ul style="list-style-type: none"> Satellite detection of AIS Possible support of future SAR
Sub functionality	<ul style="list-style-type: none"> Area warnings and advice Meteorological and hydrographic data Traffic management Ship-shore data exchange Channel management 	<ul style="list-style-type: none"> High message payload VDE satellite uplink and downlink (to be confirmed WRC-19) 	<ul style="list-style-type: none"> Ship to ship collision avoidance VTS Tracking of ships Locating in SAR VDL control (by Base Station) 	<ul style="list-style-type: none"> Detection of vessels by coastal states beyond range of coastal AIS base stations



5.1.3. Outcomes of WRC-2015 VDES

At the World Radio Conference 2015, the International Telecommunications Union identified 6 frequencies in the VHF maritime mobile band for the use of digital data transfer. The frequencies form part of the developing VHF Data Exchange System (VDES). With the ability to group these frequencies together to provide a larger band for data transfer, the VDES will enhance digital data functionality in the future.

System Concept

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. VDES will include AIS as it currently exists. New techniques that provide higher throughput using multiple [] channels which can:

- be merged to provide higher data rates
- provide simultaneous message diversity from multiple sources.

Implementation of VDES has commenced, building on the allocation of spectrum at WRC-15 where the ITU approved a standard for VDES, Recommendation ITU-R M.2092-0. A remaining outstanding issue is the approval of the satellite component for the VDE channels which is targeted for approval at WRC-19.

The system concept, including VDES functions and frequency usage are illustrated pictorially in Figure 1 VDES functions and frequency use – full system (full system, including Satellite allocations)

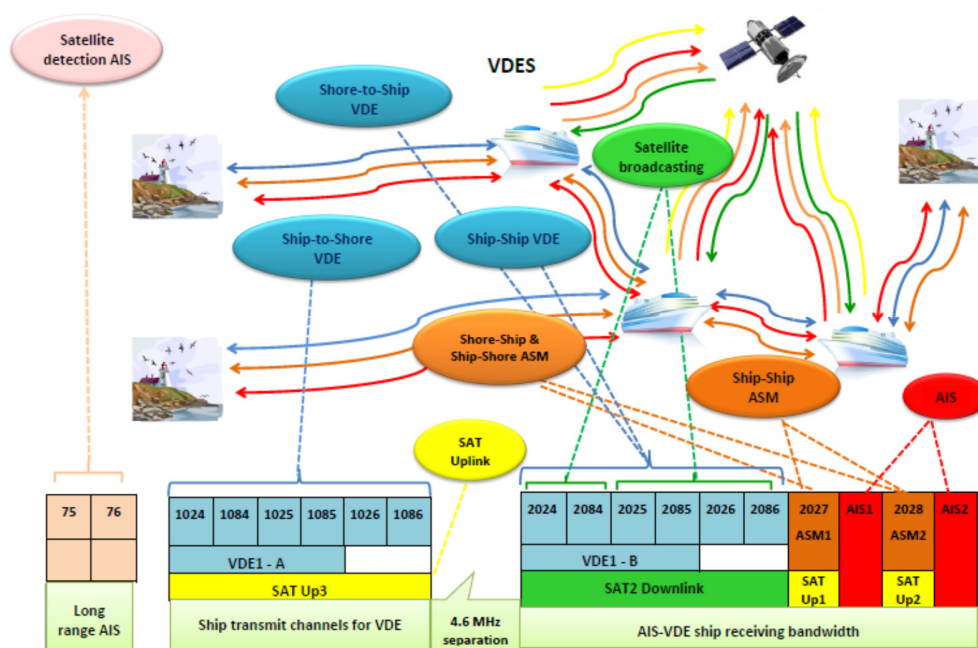


Figure 1 VDES functions and frequency use – full system

5.1.4. Frequency allocation

VDES incorporates AIS, AIS Long Range, Application Specific Messages (ASM) and VHF Data Exchange (VDE). The frequencies agreed at WRC-15 are identified below. While the VDE frequencies were agreed for terrestrial use, the

intention is to have these available for satellite use (as noted in the table). The frequencies will be highlighted at WRC-19, following extensive studies between WRC-15 and WRC-19.

The baseline for VDES spectrum allocation is according to the frequency utilisation plan illustrated in **Figure X**

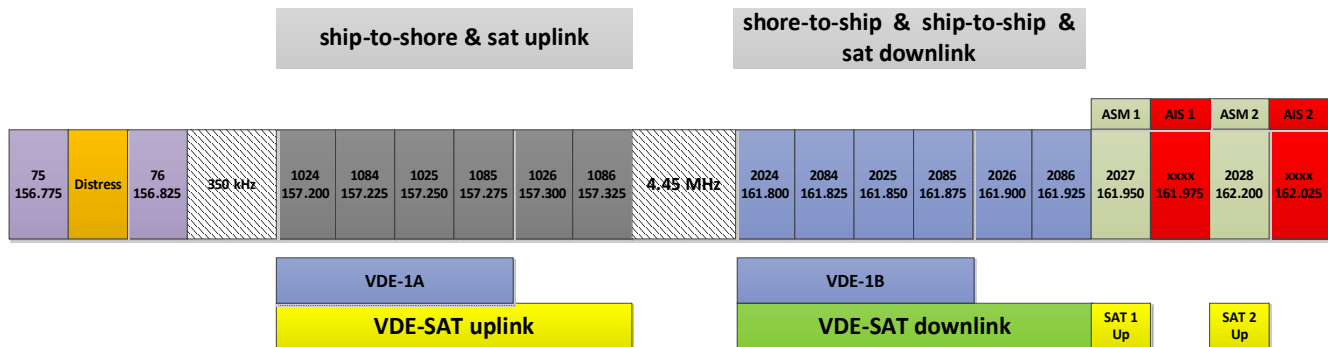


Figure 2 VDES functions and frequency use

Table 3 presents the channel allocation of VDES

Channel number in RR Appendix 18	Transmitting frequencies (MHz) for ship and coast stations	
	Ship stations (ship-to-shore) (long range AIS)	Coast stations Ship stations (ship-to-ship)
	Ship stations (ship-to-satellite)	Satellite-to-ship
AIS 1 (87B)	161.975	161.975
AIS 2 (88B)	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) (SAT Up1)	161.950 (2027) (SAT Up1)
2028 (ASM 2)	162.000 (2028) (SAT Up2)	162.000 (2028) (SAT Up2)
24/84/25/85 (VDE 1)	100 kHz channel (24/84/25/85, lower legs, merged) Ship-to-shore Ship-to-satellite (SAT Up 3)	100 kHz channel (24/84/25/85, upper legs, merged) Ship-to-ship, Shore-to-ship Satellite-to-ship under certain conditions (SAT2 possible extension)
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	50 kHz channel (26/86, lower legs, merged) VDE 2 Ship-to-satellite (SAT Up3)	50 kHz channel (26/86, upper legs, merged) Satellite-to-ship (SAT 1)

Channel number in RR Appendix 18	Transmitting frequencies (MHz) for ship and coast stations	
	Ship stations (ship-to-shore)	Coast stations
	(long range AIS)	Ship stations (ship-to-ship)
	Ship stations (ship-to-satellite)	Satellite-to-ship
26	157.300 (1026) VDE 2, SAT Up3	161.900 (2026) (SAT 1)
86	157.325 (1086) VDE 2, SAT Up3	161.925 (2086) (SAT 1)

5.1.5. VDES shore infrastructure

As VDES includes AIS, existing shore side infrastructure for AIS will continue to be effective². When planning equipment maintenance cycles, upgrading or installing new shore based infrastructure, IALA Members and other appropriate authorities providing aids to navigation should keep in mind the development and implementation of VDES. Action could be taken to install software defined radios (SDRs) with appropriate antenna installations that are capable to addressing the technical aspects of VDES. In addition, access to information for display, monitoring and recording purposes should take into account the frequency allocations and additional expected data throughput.

5.1.6. VDES and Aids to Navigation

Since VDES includes AIS, VDES will have a similar role to play in the provision of aids to navigation. In addition, VDES incorporates ASM frequencies, which can be used to support the provision of information through the system. Some aspects of existing AIS use, including some information provided through AIS to support aids to navigation, can be moved from the core AIS 1 and AIS 2 to the new frequencies. Examples can include the AtoN authority monitoring requirements (status of health of the AtoN); and information on hydrography / meteorology that is being provided for the authority and not directly provided to the mariner.

Within a VDES environment it may be possible to have information provided through multiple frequencies to address the needs of the different user groups. For example, safety related information on the AtoN could be provided through AIS (for ship use) and non-safety related information (monitoring information) on the AtoN could be provided through VDE or ASM (depending on data packet size).

² See IALA Recommendation R1007 on the introduction of VDES.



Table 4 – IALA Guidelines related to the introduction of VDES

Doc Type / Number	Doc Name	Key points	Amendment Required?	Suggested timing for amendment	Priority – H, M, L
IALA Documents ³ - Guidelines					
1008 – Ed 2 Dated: June 2009	Remote control and monitoring of aids to navigation	Provides advice on how to develop an effective, modern system when a management decision has been made to employ electronic monitoring.	Yes – currently includes AIS AtoNs noting monitoring options. In VDES there could be effective monitoring opportunities. confirm outcome from Korean workshop (Oct 2016) Put in transition framework for more revision as VDES develops	2018 Further revision 2020+ (post ITU-WRC2019)	M
Guideline 1026 Dated: December 2001	AIS as a VTS Tool	With the introduction of AIS, and noting the shore element of vessel tracking, highlights how AIS can be used to assist in the provision of VTS.	Archived		
Guideline 1027 Dated: June 2002	Designing and implementing simulation in VTS training	Specific guidance regarding the design of VTS simulation training exercises.	No amendment required – although this should be kept under review. The document has not been updated since 2002 and is due for review and reference could be made in the future to technology for simulation, including VDES (AIS).		

³ Additional IALA documentation available includes Manuals, IALA dictionary and proceedings from VTS Symposiums and IALA conferences.



Doc Type / Number	Doc Name	Key points	Amendment Required?	Suggested timing for amendment	Priority – H, M, L
Guideline 1028 Dated: December 2004	AIS – volume 1 – Part 1 – Operational issues	Presents overview of the various operational elements of AIS.	Recommend archive document. Document has not been updated since 2004, content either overtaken by events or included in other documents.		
Guideline 1029 Dated: December 2002	AIS – Volume 1 – Part 2 – Technical Issues	Presents overview of the various technical issues of AIS.	Recommend archive document. Document has not been updated since 2002, content either overtaken by events or included in other documents.		
Guideline 1032 Dated: June 2005	Aspects of Training of VTS Personnel relevant to the Introduction of AIS	A focus on additional training elements required to reflect the introduction of AIS in VTS.	Recommend archive document. Document has not been updated since 2005, content either overtaken by events or included in other documents		
Guideline 1033 – Ed 1 Dated: Dec 2003	Provision of AtoN for different classes of vessels, including high-speed craft	Responds to developments in larger and faster vessels, and the need to provide appropriate AtoN. This includes provision of AtoN for HSC and other different classes of vessels.	Yes – noting the possibility for VDES to assist with additional AtoN aspects to support different classes of vessels. confirm outcome from Korean workshop (Oct 2016) Recommend the document is reviewed as a whole to determine if still valid / update.	2019	M
Guideline 1046 – Ed 1 Dated: June 2005	Response plan for the marking of new wrecks	Developed after the wreck of the Ticolor, noting the need to mark wrecks in a timely and effective manner. Introduces the Emergency Wreck Marking Buoy.	Yes – references the use of AIS in different sections. Could introduce a generic para on VDES initially, noting the	2018 Further revision 2020+	M

Doc Type / Number	Doc Name	Key points	Amendment Required?	Suggested timing for amendment	Priority – H, M, L
			document has not been reviewed since 2005.		
Guideline 1050 Dated: December 2005	Management and monitoring of AIS	Looks at the management and monitoring of AIS information. Includes limitations of AIS, use of AIS information for accident investigations, use of AIS data for planning and evaluation processes, design and implementation of AIS data storage, handling and processing systems.	Yes – requires amending. Need to look at value of the document noting it hasn't been updated since 2005 / compare with A-124. Confirm outcomes of Korea workshop (Oct 2016)	2019+	M
Guideline 1056 Dated: June 2007	Establishment of VTS radar	Notes specific elements to be taken into account when establishing radar for VTS.	Archived		
Guideline 1057 – Ed 1 Dated: December 2007	Use of GIS by AtoN Authorities	Notes the use of Geographic Information Systems (GIS) may assist in effective AtoN planning, including evaluation and validation; ensuring that funds are invested wisely in new technology. Includes the use of AIS information as input data.	Yes – a generic para that notes AIS as part of VDES. In future, data from VDES may be able to provide additional information. Note – document is likely due for review / revision soon. Could combine with 1058	2018 Further revision 2020+	L
Guideline 1058 – Ed 2 Daated: June 2011	Use of simulation as a tool for waterway design and AtoN	The purpose of simulation for AtoN design, planning and evaluation is to identify and mitigate the risks (quantitatively) for the mariner operating in a	Yes – a generic para that notes AIS as part of VDES. In future, data from VDES may be able to provide additional information.	2018	L



Doc Type / Number	Doc Name	Key points	Amendment Required?	Suggested timing for amendment	Priority – H, M, L
		<p>specific waterway, channel and port area. It also includes evaluation (qualitatively) of channel layout, placement and technical specification of AtoN and manoeuvring aspects. (makes reference to 1057)</p> <p>Simulation offers a relatively low cost method to help ensure that the AtoN solution provided meets the users' requirements in an effective and efficient manner.</p>	Could look to combine 1057/1058. Note similar concepts in 1078 and 1104.		
Guideline 1059 Dated: June 2008	Comparison of AIS stations	Provides a comparison of the information available from different AIS stations, noting message types.	Archived – included in revised 1082		
Guideline 1062 Dated: December 2008	AIS as an aid to navigation	Additional guidance on the use of AIS as an aid to navigation. Supports Recommendation A-126	<p>Yes – add in overview para on VDES,</p> <p>Review and revise throughout based on developments of VDES / confirm outcomes of Korea workshop (Oct 2016)</p>	<p>2018</p> <p>Further revision 2020+</p>	M
Guideline 1067-0 – Ed 1.1 Dated June 2011	Selection of power systems for AtoN and associated equipment	This guideline contains descriptions of power generation, energy storage, load identification and calculation methodologies that are available for use with AtoN, together with their advantages and disadvantages.	No amendment required – generic overview and does not reference specific types of AtoN. Recommend amending 1067-1.		



Doc Type / Number	Doc Name	Key points	Amendment Required?	Suggested timing for amendment	Priority – H, M, L
Guideline 1067-1 – Ed 1 Dated May 2009	Total Electric Loads of AtoN	Provides guidance when planning to power an existing or a new AtoN, including electronic AtoN (i.e. AIS AtoN)	Yes – add in overview para on VDES. Note power requirements for future VDES base stations. Confirm outcomes of Korea workshop (Oct 2016).	2018 Further revision 2020+	M
Guideline 1069 Dated: May 2009	Synchronisation of lights	Provides guidance on the provision of synchronised lights as part of an AtoN system for marking channels, waterways, and specific areas with regard to improving the conspicuity of AtoNs, especially in areas where good conspicuity of aids to navigation is difficult to achieve due, for instance, to background lighting.	Yes – generic para on VDES, noting the possibility of using VDES to assist with synchronisation in the future. Confirm outcomes of Korea workshop (Oct 2016).	2019	M
Guideline 1070 Dated: December 2009	VTS role in managing restricted or limited access areas	Looking at when, and how, VTS manages traffic in restricted areas.	Yes – generic para on VDES, noting AIS part of VDES. Could be options to enhance management of restricted areas in the future with VDES	2018 Further revision 2020+	L
Guideline 1071 Dated: December 2009	The establishment of VTS beyond territorial seas	Identifying the issues in establishing VTS beyond territorial seas, noting the implications of existing regulations and legislation.	No amendment required at this time. Document does not go into how traffic picture is maintained – however this may be appropriate in future.		
Guideline 1072	AtoN information exchange and presentation	References e-Navigation and IMO NAV 54 - Common Maritime Information/Data Structure:	Verify document value – basically a list of standards that may be out		

Doc Type / Number	Doc Name	Key points	Amendment Required?	Suggested timing for amendment	Priority – H, M, L
Dated: December 2009		Mariners require information pertaining to the planning and execution of voyages, the assessment of navigation risk and compliance with regulation. This information should be accessible from a single integrated system. Shore users require information pertaining to their maritime domain, including static and dynamic information on vessels and their voyages.	of date noting the developments in e-Nav since 2009. Recommend verifying the value of the information / including in appropriate location (perhaps Navguide?) and withdrawing this guideline. Note – related work on information exchange in VDES / other digital comms.		
Guideline 1077 Dated: December 2009	Maintenance of AtoN	Notes that maintenance is required to ensure that Aids to Navigation (AtoN) equipment and systems continue to perform at the levels required by mariners to safely navigate the world's waterways. A maintenance system should be adopted to ensure that AtoN assets deliver the desired performance while minimizing Total Ownership Cost.	Yes – generic para on VDES, noting AIS part of VDES / VDES base stations future link with AtoN. Confirm outcomes of Korea workshop (Oct 2016)	2019	M to L
Guideline 1078 Dated: June 2011	The use of AtoN in the design of fairways	Notes the objective is to define a suitable AtoN mix that enables safe and efficient vessel passage in the most cost effective way for AtoN providers.	Yes – generic para on VDES, noting AIS is part of VDES. note outcomes of Korea workshop (Oct 2016). Could look to combine 1057/1058. Note similar concepts in 1078 and 1104.	2018 Further revision 2020+	L

Doc Type / Number	Doc Name	Key points	Amendment Required?	Suggested timing for amendment	Priority – H, M, L
Guideline 1079 Dated: Dec 2009	Establishing and conducting user consultancy by AtoN authorities	Highlights the value in establishing and conducting user consultation when planning new AtoN or changes to their existing provision of AtoN. It is not restricted to the use of physical AtoN and other types of AtoN, such as VTS, AIS and applicable parts of e-Navigation should be considered.	Yes – generic para on VDES, noting AIS is part of VDES.	2018	H
Guideline 1081 Ed 1.1 Dated: May 2013	Provision of virtual aids to navigation	Provides guidance on the use of virtual AtoN risks and benefits, criteria for application, notification process, display, etc. Notes the concept of virtual AtoN has roots in AIS but future means of transmission and presentation may evolve. AIS should not be construed as limiting virtual AtoN to that system.	Yes – add in generic para of VDES, noting AIS part of VDES. Confirm outcomes from Korea workshop (Oct 2016).	2018	H
Guideline 1082 Dated: June 2016	An overview of AIS	Provides an introduction to AIS at an overview level for shore authorities and references relevant documentation where further information can be found.	Yes – generic para on VDES, noting AIS part of VDES.	2018	H
Guideline 1084 Dated: June 2011	Authorisation of AIS AtoN	Refers to A-126 and Guideline 1062. Identifies a procedure to authorise AIS AtoN.	Yes – generic para on VDES, noting AIS is part of VDES. Note link to ITU and unique ID as this develops.	2018 Further revision 2020+	M

Doc Type / Number	Doc Name	Key points	Amendment Required?	Suggested timing for amendment	Priority – H, M, L
			Recommend this is merged with Guideline 1062 in the future.		
Guideline 1085 Dated: June 2012	Standard format for electronic exchange of AtoN product information	<p>AtoN authorities are making wide use of various database centric online asset management systems for managing AtoN equipment. Once the information on a particular product is entered into the database the information can be accessed by all relevant stakeholders within an organisation.</p> <p>If AtoN equipment information was provided by manufacturers electronically in an agreed format it would be able to be loaded easily into the AtoN authority's systems, saving time and eliminating data entry errors.</p>	<p>Yes - generic para on VDES, noting AIS is part of VDES.</p> <p>Review as a whole to see if there is any impact from VDES on the PIF.</p>	<p>2018</p> <p>Further revision 2020+</p>	M
Guideline 1086 Dated: June 2012	Global sharing of maritime data and information	Promotes IALA-Net.	Yes - generic para on VDES, noting AIS is part of VDES.	2018	L
Guideline 1088 Dated: December 2012	Introduction to preparing S-100 product specifications	This Guideline introduces the process of developing S-100 Product Specifications. It is not intended to enable those unfamiliar with S-100 to develop Product Specifications, as that requires specialist knowledge of data modelling. The Guideline draws on Appendix A of IHO S-	<p>No amendment required at this time.</p> <p>Need to confirm how VDES may be referenced in future product specification as the system develops.</p>		



Doc Type / Number	Doc Name	Key points	Amendment Required?	Suggested timing for amendment	Priority – H, M, L
		100, but reference should be made to that document for a more detailed description of the process.	Recommend verifying how this fits with guideline 1106		
Guideline 1089 Dated: December 2012	Provision of VTS (INS, TOS and NAS)	Gives guidance on the delivery of the three different types of services provided by a VTS; Information Service (INS), Traffic Organization Service (TOS) and Navigational Assistance Service (NAS). This guideline also aims to achieve consistency in the provision of the services worldwide in order to avoid confusion about the delivery of VTS services for the mariner trading between various jurisdictions.	Yes - generic para on VDES, noting AIS is part of VDES.	2018	L
Guideline 1095 Dated: May 2013	Harmonised implementation of ASMs	References IMO documents, ITU document and regional message. Provides means to harmonize establishment.	Yes – generic para on VDES, noting AIS is part of VDES. Confirm outcomes from Korea workshop (Oct 2016) As VDES developments, some ASMs will move off AIS 1 and AIS 2. Complete revision of guidance on ASM will be required. Note inconsistent use of 'z' in harmonised / harmonized.	2018 Further revision 2020+ (post ITU-WRC2019)	H
Guideline 1096	Anticipated user e- Navigation requirements from	Written prior to the release of the IMO e-Navigation implementation	Yes – generic para on VDES, noting AIS is part of VDES.	2018	M to H



Doc Type / Number	Doc Name	Key points	Amendment Required?	Suggested timing for amendment	Priority – H, M, L
Dated: May 2013	berth to berth, for AtoN authorities.	plan. References AIS, including AIS related to AtoN.	Confirm outcomes from Korea workshop (Oct 2016) May need to review as a whole now IMO has released the SIP.		
Guideline 1097 Dated: May 2013	Technical features and technology relevant for simulation of AtoN	Makes reference to guideline 1058, notes that 1097 provides greater technical guidance, supplementing 1058.	Yes – generic para on VDES, noting AIS is part of VDES. Recommending reviewing both 1058 and 1097 with a view to merging in the future.	2018	M to L
Guideline 1098 Dated: May 2013	Application of AIS AtoN on buoys	Offers guidance regarding specification, installation and maintenance. Compliments A-126.	Yes – initially a generic overview, but future will require a full revision noting the different message types referenced (including binary / ASMs). Recommend reviewing how this fits with guidelines 1095, 1085, 1084, 1081, 1077, 1067-1, 1062	2018 Further revision 2020+	H
Guideline 1101 Dated: December 2013	Auditing and assessing VTS	Provide guidance for competent authorities and VTS authorities to meet their obligations under SOLAS for the establishment and operation of VTS. In particular, it aims to provide guidance for auditing and assessing a VTS and the subsequent on-going assessment and evaluation	Yes – generic para on VDES, noting AIS is part of VDES.	2018	L
Guideline 1102	VTS interaction with allied or other services	Describes the issues to be considered and the principles to be respected for successful	No amendment necessary at this time.		

Doc Type / Number	Doc Name	Key points	Amendment Required?	Suggested timing for amendment	Priority – H, M, L
Dated: December 2013		interaction between VTS and allied or other services.	May wish to review as shore side communications structures develop in support of e-navigation.		
Guideline 1104 Dated: December 2013	Application of maritime surface picture for risk assessment and provision of AtoN	This document provides guidance on the use of GIS to assess the requirement and impact of AtoN in the area of interest. It covers incorporation of charting overlays with new dangers and amplification of existing dangers. Automatic Identification System (AIS) data will be used to determine traffic profile and volume.	Yes – generic para on VDES, noting AIS is part of VDES. Recommend review / merge with guidelines 1078, 1058, 1057.	2019	L
Guideline 1105 Dated: December 2013	Harmonized portrayal of e-Navigation related information	The objective of this document is to provide guidance on how to achieve a " <i>harmonized presentation</i> " of information ashore with the presentation on board in the e-Navigation context	Yes – generic para on VDES, noting AIS is part of VDES. Confirm outcomes from Korea workshop (Oct 2016) Recommend reviewing /confirming relationship with guideline 1088	2018	M
Guideline 1106 Dated: December 2013	Producing an IALA S-100 Product Specification	Aims to provide a common understanding of what is needed to implement products in the S-100 registry. Notes the IALA Domain within the IHO Registry is being created to provide standardized information in fields such as ATON, VTS and AIS	Yes - generic para on VDES, noting AIS is part of VDES. Future – will need to verify how VDES fits with S-100 overall. This can be done as VDES develops, to ensure compatibility of systems.	2018 & 2021	M

Doc Type / Number	Doc Name	Key points	Amendment Required?	Suggested timing for amendment	Priority – H, M, L
		support of the e-Navigation initiative.	Recommend verifying how this fits with guideline 1088.		
Guideline 1108 Dated: December 2013	Challenges of providing AtoN services in polar regions.	Address the specific challenges in implementing AtoN in polar regions, noting the areas are changing fast and can be expected to lead to new, seasonal shipping routes opening.	Yes – generic para on VDES, noting AIS is part of VDES. Can also note the development of VDES satellite aspect – may be opportunity to use this to support the work at ITU leading to WRC-19. .	2018	M
Guideline 1110 Dated: December 2014	Use of decision support tools for VTS personnel	Provides guidance on the use of DST for VTS when considering decisions on evolving or emergency situations.	Not required at this time.		
Guideline 1111 Dated: May 2015	Preparation of operational and technical performance requirements for VTS systems.	Provides a common source of information to assist Competent Authorities and VTS Authorities in the preparation and establishment of operational and technical performance requirements.	Yes – generic para on VDES, noting AIS is part of VDES. Can include guidance for the possible future of VDES base stations / link with ASM (confirm outcome of Korea workshop, Oct 2016). section 3 (AIS) will need full revisions as VDES develops.	2018 Further revision 2020+	M
Guideline 1113 Dated: May 2015	Design and implementation principles for harmonised system architectures of shore based infrastructure	This Guideline establishes relevant principles for the design and implementation of harmonised shore-based technical system architectures. Identifies consequences from the international context for design and implementation of harmonised bore-based technical	Yes – a general overview and integration text as appropriate – this will be a key document for review and update as VDES develops. There is a general requirement to consider VDES with regards to all forms of data exchange / formats for common shore-based system architecture.	2018 Further revision 2020+	M



Doc Type / Number	Doc Name	Key points	Amendment Required?	Suggested timing for amendment	Priority – H, M, L
		system architecture; identifies principles for seamless and traceable system engineering requirements; introduces the CSSA (see guideline 1114... note – 1114 is not referenced in 1113).	Need to confirm how this fits with 1114 Number is missing from header after page 1 (yellow highlight).		
Guideline 1114 Dated: May 2015	Technical specification for the Common Shore-based System Architecture (CSSA)	A best practice representation of a system layout which was designed, amongst other reasons, as a system engineering response to the prompt for a common technical shore-based system harmonised for e-Navigation (incl. its Human-Machine-Interfaces)' as implied by IMO's overarching architecture for e-Navigation	Yes – a general overview and integration text as appropriate – this will be a key document for review and update as VDES develops.	2018 Further revision 2020+ (post ITU-WRC2019)	M

6. Non-IALA Documents

There may be a requirement to revise non-IALA documents as noted below. Consistent terminology may be possible by using text provided for IALA document review.

Table 5 Non-IALA documents related to VDES

Doc Type / Number	Doc Name	Key points	Amendment Required?
IMO Documents ⁴			

⁴ Note – additional IMO documents identified in the literature review include a number of related circulars which provide further guidance for members. These documents have been included in the reference file for the thesis work, but are not listed here.



Doc Type / Number	Doc Name	Key points	Amendment Required?
Convention / SOLAS Chapter V, Regulation 10	Ships routing	Identifies that ships' routing systems contribute to safety, efficiency and marine environmental protection. Indicates process for establishing a ships' routing system. (reference to Resolution A.572(14), as amended)	No need to amend for VDES
Convention / SOLAS Chapter V, Regulation 11	Ship reporting systems	Refers to ship reporting systems other than those established for search and rescue under the SAR convention. Identifies that ships' reporting systems contribute to safety, efficiency and marine environmental protection. Indicates process for establishing such systems. (reference to Resolution MSC.43(64) as amended by MSC.111(73). Also references A.851(20) for reporting of incidents involving dangerous goods.)	No need to amend for VDES (does not specifically indicate how ships report)
Convention / SOLAS Chapter V, Regulation 12	Vessel Traffic Services	Identifies that VTS contributes to safety, efficiency and marine environmental protection. Indicates need for risk analysis to determine need for VTS. (reference to Resolution A.857(20))	No need to amend.
Convention / SOLAS Chapter V, Regulation 19.2.4	AIS	Indicates carriage requirements for AIS Notes that AIS on ships is expected to exchange information with shore stations.	Amendment required – note AIS is part of VDES.
Convention / SOLAS Chapter V, Regulation 19-1	Long range identification and tracking	Notes that the regulation does not prejudice the rights, jurisdiction or obligations of States under international law. Indicates that ships are required to transmit specified information and that Contracting governments shall be able to receive LRIT for security and other purposes. (reference to Resolution MSC.242(83), MSC.263(84) and MSC.275(85) as may be revised; references related circulars)	No need to amend
Convention / SOLAS Chapter V, Regulation 34	Safe navigation and avoidance of dangerous situations	References the requirement to prepare a voyage plan, taking into account any relevant ships' routing systems. (reference to Resolution A.893(21)).	No need to amend



Doc Type / Number	Doc Name	Key points	Amendment Required?
Convention / SAR Chapter 5	Ship Reporting Systems	Identifies that ship reporting systems may be established to facilitate search and rescue operations. (reference to Resolution A.851(20))	No need to amend
Convention / MARPOL	Protocol I, Provisions concerning reports on incidents involving harmful substances.	Highlights the duty to report, when to report and the reporting process should a ship be involved in an incident where discharge is above a permitted level. Includes reference to supplementary reports and reporting procedures. (reference to Resolution A.851(20))	No need to amend
Resolution A.572(14) Dated: 1985, amended 1995	General Provisions on Ships' Routeing. amended by MSC.71(69); MSC.165(78); MSC280(85); see also SN/Circ.241	Indicates the objectives of ships' routeing, provides definitions on such elements of routeing including: traffic separation schemes, inshore traffic zone, deepwater routes and recommended direction of traffic flow. Notes the procedures for establishing and methods of routeing, including design criteria.	No need to amend
Resolution A.851(20) Dated: 2 December 1997	General principles for ship reporting systems and ship reporting requirements. Amended by MEPC.138(53)	The resolution includes reference to guidelines for reporting incidents involving dangerous goods, harmful substances and/or marine pollutants. General principles indicate that reports should contain only information essential to achieve the objectives of the system and a goal to keep the number of reports to a minimum. Types of reports are identified, as well as standard reporting formats.	No need to amend, although could note automated reporting options
Resolution A.857(20) Dated: 3 December 1997	Guidelines for Vessel Traffic Services	Provides definitions of terms connected with VTS, indicates objectives of VTS, responsibilities and liabilities for the Contracting Government (or competent authority) and the VTS authority. Includes guidance concerning the VTS services provided. Identifies requirements for planning for VTS, operating procedures, equipment and training.	No need to amend for VDES / could note as part of the review that the VTS Committee has on their workprogramme

Doc Type / Number	Doc Name	Key points	Amendment Required?
Resolution A.893(21) Dated: 4 February 2000	Guidelines for voyage planning. Related A.999(25) and MSC/Circ.1056	Notes the requirement to take into account ships' routing and reporting systems, vessel traffic services and marine environmental protection measures.	No need to amend
Resolution MSC.43(64) Dated: 9 December 1994	Guidelines and criteria for ship reporting systems. Amended by MSC.111(73), MSC.189(79). Revised by MSC.113(73)	Identified general considerations to be taken into account, including objectives of the system, communication means, the role of the shore based authority and participating ships. Includes criteria for planning, proposing and implementing systems, including process for adoption by the IMO.	No need to amend
Resolution MSC.242(83) Dated: 12 October 2007	Use of long-range identification and tracking (LRIT) information for maritime safety and marine environment protection purposes.	Indicates that LRIT can be used not only for security, but also for safety and marine environment protection purposes.	No need to amend
Resolution MSC.263(84) Dated: 16 May 2008	Revised performance standards and functional requirements for the long range identification and tracking of ships (LRIT)	Identifies the structure of the LRIT system, and explains each of the elements of the system. There are also a suite of related MSC.1 circulars including MSC.1/Circ.1298 on the implementation of LRIT and MSC.1/1259 and MSC.1/1294 for technical documentation.	No need to amend / could have VDES as a means to provide data into LRIT in future.
Resolution MSC.275(85) Dated: 5 December 2008	Appointment of LRIT coordinator	Indicates that the International Mobile Satellite Organisation (IMSO) is appointed as the LRIT coordinator.	No need to amend



Doc Type / Number	Doc Name	Key points	Amendment Required?
Resolution MSC.74 (69) Annex 3 Dated: 12 May 1998	Performance standards for AIS	Includes the functionality, capability and user interface (MKD) of AIS. Notes that MMSI is used for ship / message identification. Identifies the information sent – static, dynamic and voyage related.	Need to amend to note AIS is part of VDES (proposal from US for MSC 98)
Resolution MSC.140(76) Dated: 5 December 2002	Protection of the AIS VHF data link (VDL)	Recognizes the developments in AIS, specifically with reference AIS Class B and the impact that this could have on the VDL. Recommends that administrations take steps necessary to ensure the integrity of the VHF channels used for AIS.	Need to amend to reflect VDES (protection of VDES spectrum?)
Resolution A.917(22) Dated: 29 November 2001	Operational Guidelines for onboard use of AIS	Provides information on the expected operation of AIS onboard SOLAS vessels, including: activation; data entry; confirmation of information; display of data; limitations in the use of AIS.	Need to amend to reflect AIS as part of VDES / operational guidelines for onboard use of VDES?
Resolution A.956(23) Dated: 5 December 2003	Amendments to the guidelines for onboard operational use of AIS		
Resolution MSC.246(83) Dated: 8 Oct. 2007	Performance standards for AIS-SART	Identifies the requirements for an AIS SART, including operational requirements and battery capacity.	No need to amend (at this time) / may be reviewed as part of the AMRD work
Publication	Standard Marine Communications Phrases (2002)	Stresses the fact that the IMO SMCP have been compiled to assist in greater safety of navigation, to standardize language use and to assist maritime training institutions. Highlights the concept of message markers. Section A 1/6 presents VTS standard phrases.	No need to amend (at this time) / ability to use coded reference for language independent comms in VDES. Note IALA work to revise VTS related phrases



Doc Type / Number	Doc Name	Key points	Amendment Required?
ITU Documents ⁵			
ITU-R M.1371-5 Dated: 2014	Technical Characteristics for AIS using TDMA in the VHF maritime mobile band	Identifies the technical requirements for AIS, including the different TDMA protocols Presents tables for update rates for Class A and Class B (CS); complete message lists; transceiver and receiver characteristics.	Initially keep as is (working towards 1371-6). Will need to see how this fits with VDES related recommendations in future.
ITU-R M.585-5 Dated 10 / 2009	Assignment and use of maritime mobile service identities (MMSIs)	Presents the numbering systems in use for MMSIs for the purposes of ship stations; coast stations; aircraft; Aids to Navigation; craft associated with a parent ship;	No amendment needed Will need a Unique Numbering system for VDES, but not MMSIs.
ITU-R M.1084-5 Dated 2014	Interim solutions for improved efficiency in the use of the bank 156-174 MHz by stations in the maritime mobile service	Indicates the possible move to migrate to narrow-band channel spacing (5kHz or 6.25kHz in future, initial move from 25kHz to 12.5kHz). The 'freeing up' of bandwidth will enable increased use of the existing spectrum, expected to be an issue in the development of e-navigation.	No amendment necessary
ITU-R M.2092-0 Dated: 2015	Technical Characteristics for a VHF data exchange system in the VHF maritime mobile band	Presents technical characteristics of a VHF data exchange system (VDES) which integrates the functions of VHF data exchange (VDE), application specific messages (ASM) and the automatic identification system (AIS) in the VHF maritime mobile band (156.025-162.025 MHz)	Amendment required as VDES develops (core VDES document)

⁵ Note – a number of additional work elements for ITU Study Group 5B (maritime radio) have also been identified. As these represent work that is developing, they have not been included here, but do form part of the reference file for the thesis development. The results of the World Radio Conference 2012 will also be taken into account as the thesis develops.



7. Appendix A – Proposed documentation structure for VDES and related documents

7.1. Introduction

There are few well documented documentation guidelines. There are however many documentation templates that lay out the construction of any one particular type of document (report, specification, product guide, etc.).

The basis of VDES development appears to be based in the Systems Engineering (SE) domain. Figure A-1 presents the overlapping elements within a SE environment.

The advances in the SE documentation domain have been primary around a concept know as Model Based Systems Engineering (MBSE). In MBSE models are being used to segment or even replace the documentation that defines the entire SE life cycle from concept to retirement.

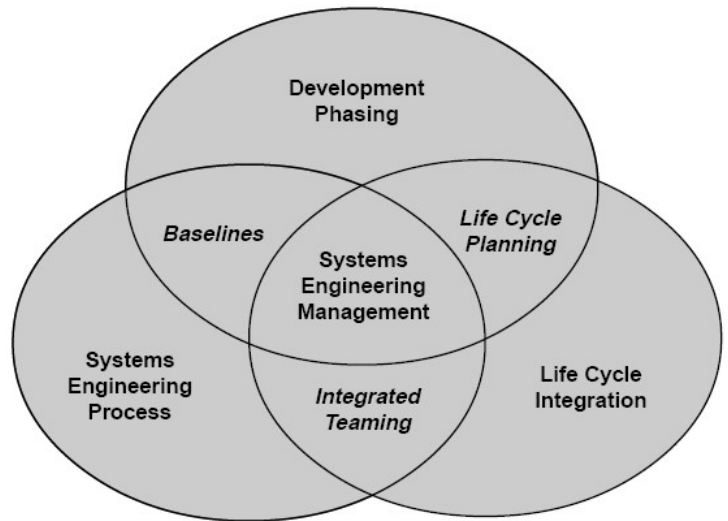


Figure 3 Systems Engineering (SE) Domain

Although methodology may often, and erroneously, be considered the same as a process, the differences between methodology, process, tools and the environment (known as PMTE).

The **process** can be thought of as a logical sequence of tasks performed to achieve an outcome – the ‘what’ is to be done, without saying ‘how’ each task is performed. The **method** is then the ‘how’ each task is performed. The **tools** used to perform the tasks that, within a specific method, can be used to effectively and efficiently complete the task within an **environment** where the person using the tools has the appropriate knowledge, skills and abilities (KSA)⁶. Figure A-2 presents a visual representation of PMTE as a linking factor between technology and people.

⁶ Survey of Model-Based Systems Engineering (MBSE) Methodologies, Jeff A Estefan Jet Propulsion Laboratory California Institute of Technology Pasadena, California, U.S.A. Jeffrey.A.Estefan@jpl.nasa.gov May 23, 2008



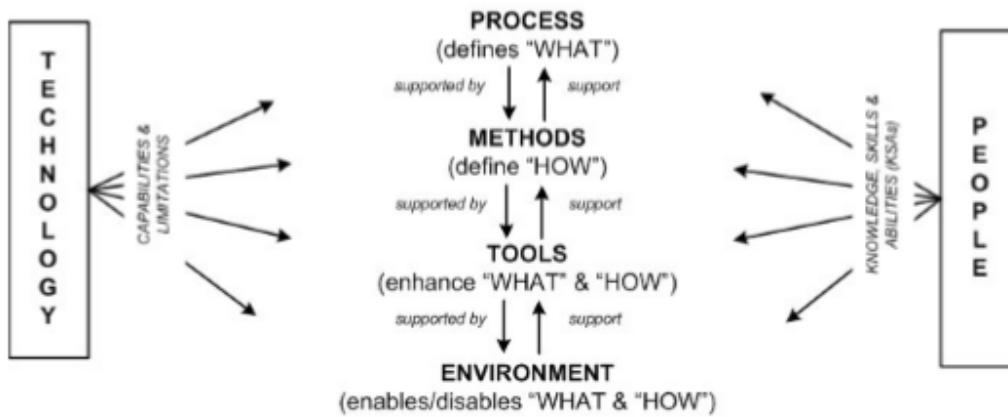


Figure 4 Visual representation of PMTE

Within the context of MBSE, the capabilities and limitations of technology must be considered when developing a systems engineering development environment – working to ensure that something isn't done / introduced simply because it is technically possible.

7.2. MBSE concept applied to VDES documentation

The MBSE methodology does not require a binary choice between documentation or models, but allows for the migration from a traditional fully documented to a MBSE approach.

For the most part, the basis for the development of much of IALA documentation is based on the traditional, fully documented approach. In recent years, some documents have begun to embrace MBSE, such as the IALA Guidelines No. 113 and 114 ((common shore-based system architecture). The development of VDES documentation is reflecting MBSE concepts. This is seen in the modelling of the Software Defined Radio (SDR) performance and also the requirement for agreement on the VDES frequencies.

An interesting and appealing aspect of the MBSE concept is the simplicity of concept and how easily this overlaps the existing documentation model. As such, there is an opportunity to migrate, over time, to a documentation model espouses the elements of MBSE without negating the existing excellent and detailed documents that make up the IALA technical library.

Within an ever increasingly complex and technology focused environment, The MBSE concept and development is coming of age. A documentation structure that takes onboard the elements of MBSE enables the organization to adapt and work in an agile manner. Figure A-3 provides an overview of the concept of complexity vs time.

MBSE extends beyond engineering to approach an objective from a standards-based approach, integrating the technical elements with the operational domain, with a focus on effective, valid and appropriate responses making the best use of both technology and human abilities.

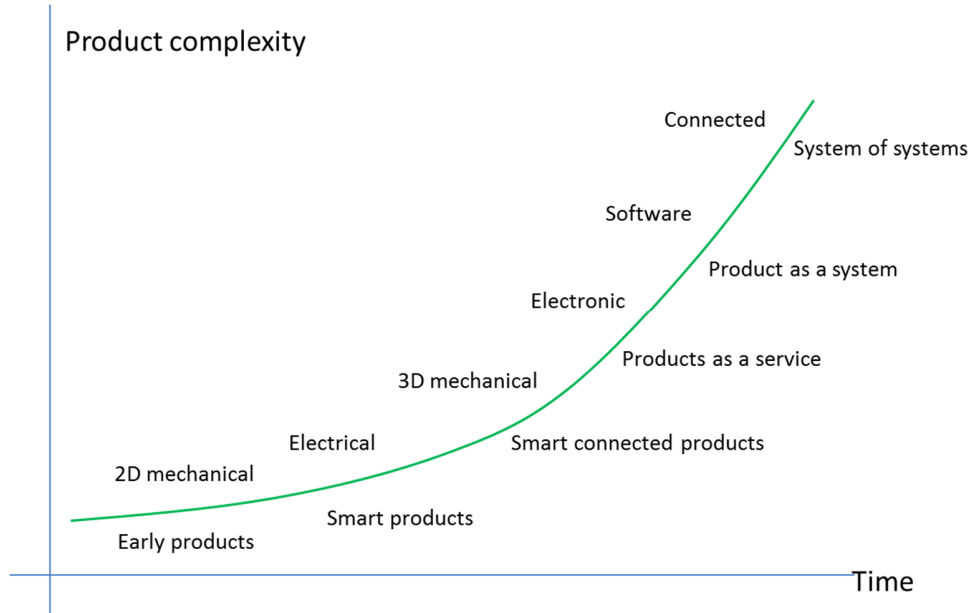


Figure 5 Concept of complexity vs time

7.3. MBSE process description

As the goal of MBSE is to move from a document centric approach to a model centric approach, the ‘documentation’ structure proposed is actually based on the model approach. To enable structured access to information, the approach could be seen as having four key document areas:

Concept documents (Process aspect in PMTE) – ‘what’ is to be done. Documents are high level, basically a concept of operations, including documentation of the ‘why’ for the item being described (e.g. concept of operations documents; user requirements)

Development documents (Methods aspect in PMTE) – the ‘how’ something is done. Documents include more technical detail (e.g. system requirements, standards)

Production documents (Tools aspect in PMTE) – the ‘what’ and ‘how’ something works. Documents become more specific, and may relate to each other in an organic manner – whereby elements are accessed at different levels of documentation. (e.g. architecture documents, implementation information)

Operations and Support documents (Environment aspect in PMTE) – providing information on how something works within an environment, interaction with users. (e.g. operational documents; training requirements; maintenance requirements)



The MBSE process is graphically described in Figure A-4 (the so called 'W' diagram extracted and adapted from a variety of sources):

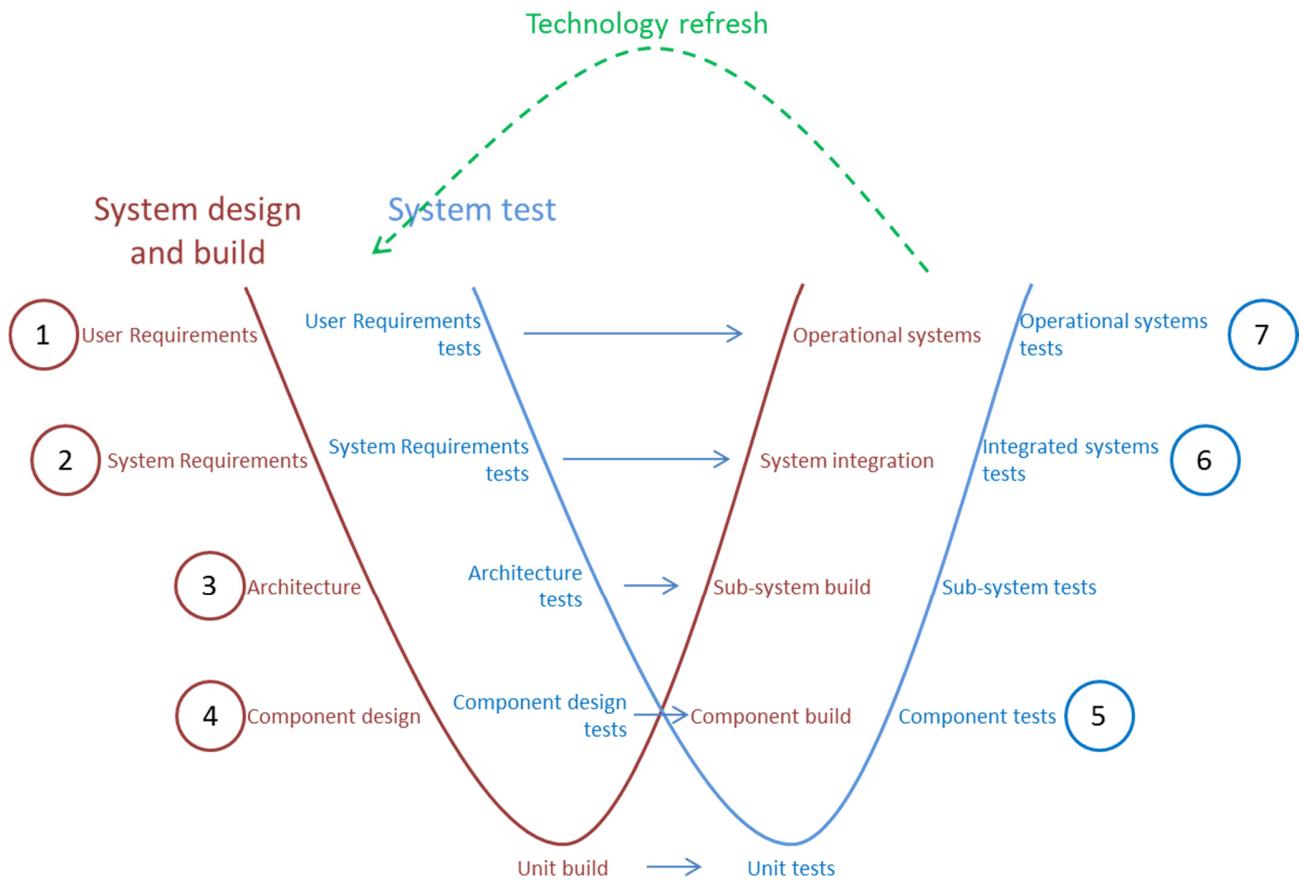


Figure 6 – 'W' design for MBSE

7.4. Adopting MBSE in IALA Documentation

Rather than a full-scale revision of IALA documentation, the MBSE could be adopted into IALA documents in an organic manner. This could be achieved through a base documentation overview approach, with indication of where IALA documentation (existing) fits within the new approach; identifying any gaps for MBSE and also identifying any existing IALA documents that do not fit within an MBSE context.

Table 6 Table Use of MBSE in IALA documentation

Document:	Generic examples	Examples in VDES	Examples in VTS
Concept	Conop General Overview User requirements	<ul style="list-style-type: none"> VDES Overview User Requirements 	IMO SOLAS V, Reg. 12; A.857(20)
Development	System requirements Technical overview		
Production	System architecture		
Operations and Support	Operations Maintenance Training		

8. References

Survey of Model-Based Systems Engineering (MBSE) Methodologies

Jeff A. Estefan Jet Propulsion Laboratory California Institute of Technology Pasadena, California, U.S.A.
Jeffrey.A.Estefan@jpl.nasa.gov May 23, 2008