# Introduction

## Purpose of the Document

This Guideline has been prepared to provide technical information required in the development of VDES equipment, 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).

This document refers to ITU Recommendation ITU-R M.2092-0, and is not intended to replace that document. The IALA Guideline on Technical Specifications of VDES provides additional detail on VDES, and will be amended as required to reflect experience in implementing the technical solutions for VDES. As this IALA Guideline is revised, input will be included, as appropriate, as a working document towards a revision of ITU-R M.2092. It is intended that this input will be provided to the appropriate working group of ITU following the results of the ITU WRC-19.

Persons using this document are encouraged to provide comments, corrections and further input on developments to IALA. In addition, persons who are implementing VDES are invited to participate in further work on the system through the IALA ENAV Committee. It is noted that, as VDES develops, any deployment of VDES will need to comply with the appropriate ITU regulation, once they are agreed.

It is noted that, following WRC-15, the full satellite capability of VDES is being studied at ITU and will be reviewed at WRC-19. This IALA Guideline includes the full capability (including satellite).

## Background

AIS is well recognised and accepted as an important tool for safety of navigation and is a carriage requirement for SOLAS vessels (Class-A). With increasing demand for maritime VHF data communications, AIS has become heavily used for maritime safety, maritime situational awareness and port security. As a result, high loading of AIS 1 and AIS 2 created a need for additional VHF data channels. Using the VHF marine band (International Radio Regulations Appendix 18) AIS can broadcast data to vessels in the vicinity of the AIS unit. AIS can also transmit an addressed message.

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

Both voice and data communications coexist in the VHF marine band. The developments in maritime radio technology, including the introduction of software defined radios (SDR) coupled with enhanced capabilities for digital data exchange over existing VHF marine band spectrum resulted in the development of the VHF Data Exchange System (VDES). VDES builds on the experience gained through the development of AIS, and also provides the capability to transmit to a specific vessel (addressed); to all units in the vicinity (broadcast); to a group of vessels (addressed); or to a fleet of vessels (addressed).

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

The expected implementation pf VDES is provided in Figure [1](#fig:Implementation_of_VDES).

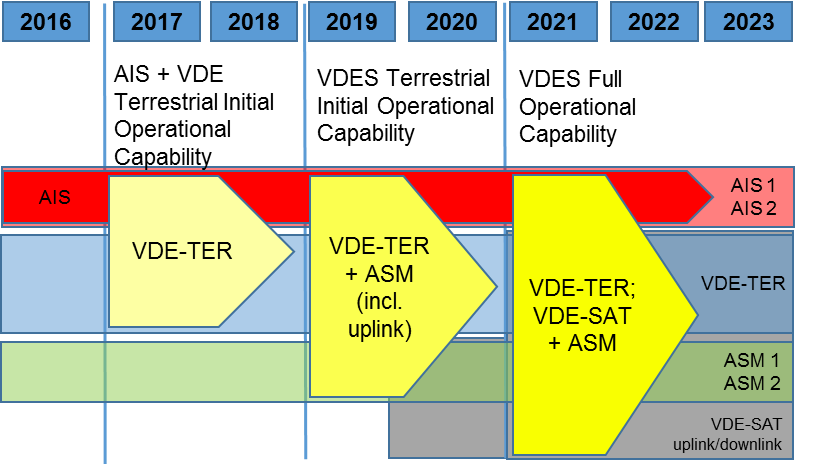


Figure 1: Implementation of VDES.

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

1. (2016) AIS exists as defined by ITU.R M.1371-5 on the AIS frequencies, and Coastal Stations use the ASM and VDE frequencies for Voice VHF.
2. (2017-2018) Post WRC-15 - AIS+ASM: Regionally, where there is an urgent need for offloading the AIS VDL from significant ASM traffic, it is recommended to allow the introduction of 4-channel AIS + ASM devices. These devices may receive and transmit ASM on the ASM1 and ASM2 frequencies, but shall discontinue their transmit capability, using the existing GMSK modulation after January 1st 2019 unless a software upgrade enables them to participate in the modulation and access scheme agreed for the ASM frequencies according Recommendation ITU-R M.2092. Note that the ASM frequencies will need to be shared with the VHF voice service from Coast Stations in many areas during this time frame.
3. (2019) the WRC-19 will consider and decide regarding VDE-SAT.
4. (2019-2020) Post WRC-19 operational capability established. Note that both the ASM and VDE frequencies may still need to be shared with the voice VHF service in many areas.
5. (2021+) When a satellite service is developed, full operational capability of the VDES including the Satellite frequencies can be achieved.

## Document Structure

The document is provided in a series of Annexes.

Annex A - provides common technical elements of VDES

Annex B - describes the technical characteristics of the ASM channel that will support applications specific messages in order to improve the efficiency of application-specific message transmissions and to protect the original function of the AIS. The ASM channels will also support a satellite uplink.

Annex C - describes the technical characteristics of the VDE terrestrial channels providing an efficient terrestrial data transfer link enabling a wide variety of applications for the maritime community.

Annex D - describes the technical characteristics of VDE-SAT Service that will support multi-cast multi-package data transfers and shore originated unicast multi-package data transfers via satellite.

Annex E - describes the characteristics necessary for each component of the VDES to share the available spectrum such that impact between services is minimized and AIS is respected.

# Operational Characteristics

In general, VDES should meet the following:

1. The system should give its highest priority to the automatic identification system (AIS) position reporting and safety related information.
2. The system installation should be capable of receiving and processing the digital messages and interrogating calls specified by this Recommendation.
3. The system should be capable of transmitting additional safety information on request.
4. The system installation should be able to operate continuously while under way, moored or at anchor.
5. The system should use for the terrestrial links time-division multiple access (TDMA) techniques, access schemes and data transmission methods in a synchronized manner as specified in the Annexes.
6. The system should be capable of various modes of operation, including the autonomous, assigned and polled modes.
7. The system should provide flexibility for the users in order to prioritize some applications and, consequently, adapt some parameters of the transmission (robustness or capacity) while minimizing system complexity.
8. The system should address the use cases identified in Report ITU-R M.2371.

## General Description of VDES

A detailed overview of VDES, and VDES operations, is provided in IALA Guideline 1117 (latest edition). In essence, The VDES provides a variety of means for the exchange of data between maritime stations, ship-to-ship, ship-to-shore, shore-to ship, ship-to-satellite and satellite-to-ship. The VDES functionally includes the AIS, either by integration, by interface connection or by radio frequency connection.

## VDES Functions and Frequency Usage

The system concept, including VDES functions and frequency usage are illustrated pictorially in Figure [2](#fig:VDES_functions_and_frequency_use) (full system). Please note – SAT Up is received only by Satellite.

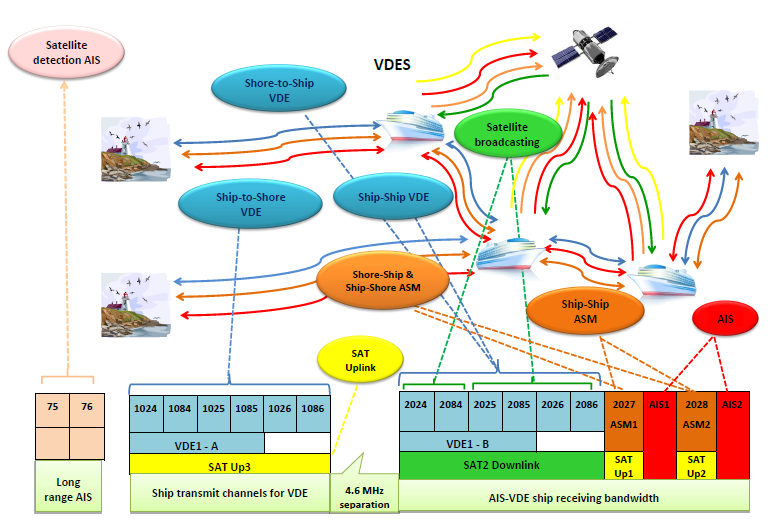


Figure 2: VDES functions and frequency use - full system

# VDES Channel Usage in Accordance with ITU RR Appendix 18

This section provides information on channel usage between terrestrial stations and between satellite and terrestrial stations.

## VDES: Data Exchange between Terrestrial Stations

* AIS 1 (channel 2087) and AIS 2 (channel 2088) are AIS channels, in accordance with Recommendation ITU-R M.1371
* ASM 1 (channel 2027) and ASM 2 (channel 2028) are the channels used for application specific messages (ASM)
* VDE1-A lower legs (channels 1024, 1084, 1025, 1085) are ship-to-shore VDE
* VDE1-B upper legs (channels 2024, 2084, 2025, 2085) are shore-to-ship and ship-to-ship VDE.

## VDES: Data Exchange between Satellites and Terrestrial Stations

* AIS 1 (channel 2087) and AIS 2 (channel 2088) are terrestrial AIS channels that are also used as uplinks for receiving AIS messages by satellite
* Long Range AIS using channel 75 and channel 76 are specified channels to be used as uplinks for receiving AIS messages by satellite. SAT Up1 (channel 2027) and SAT Up 2 (channel 2028) are used for receiving ASM by satellite
* SAT Up3 (channels 1024, 1084, 1025, 1085, 1026 and 1086) are used for ship-to-satellite VDE uplinks
* SAT Downlink (channels 2024, 2084, 2025, 2085, 2026 and 2086) are used for satellite-to-ship VDE downlinks.

# Identification

Identification and location of all active maritime stations is provided automatically by means of the AIS. All VDES stations should be uniquely identified. For the purpose of identification, a unique numerical identifier is used as defined by the following:

* If the unique identifier has a range which is less than 999999999, then this number is defined by the latest version of Recommendation ITU-R M.585.
* If the unique identifier has a range which is greater than 999999999, then this is number is free form.

# Presentation Interface Protocol

For VDES transceivers:

* data may be input via the presentation interface to be transmitted by the VDES station;
* data received by the VDES station should be output through the presentation interface.

# Technical Characteristics

A general overview of the technical aspects of VDES is provided in IALA Guideline 1117. This section provides more detailed technical characteristics.

## Shipborne VDES Receivers are Protected

As in AIS, shipborne VDES receivers are on the upper legs of RR Appendix 18, 4.6 MHz above the lower legs, which facilitates protection by filtering from receiver blocking by ships VHF radios.

## SAT Downlink

The satellite downlink complies with the power flux-density (PFD) mask described in Table A4-1 to minimize interference to terrestrial services and to maximize reception by ship VDES stations.

## VDES1 Uses Both Legs of the Duplex Channels

Channel capacity is utilized for the duplex channels in VDE1 by using the lower legs (VDE1-A) for ship-to-shore and the upper legs (VDE1-B) for shore-to-ship and ship-to-ship digital messaging.

Table [1](#tbl:RR_Appendix_18_channels_for_VDES_applications) describes the RR Appendix 18 channels used for the various applications of VDES.

Table 1: RR Appendix 18 channels for VHF data exchange systems applications: Automatic identification system, application specific messages, VHF data exchange

|  |  |  |
| --- | --- | --- |
| RR Appendix 18 channel number | Transmitting frequency (MHz) - Ship-to-shore, long range AIS, ship-to-satellite | Transmitting frequency (MHz) - Shore-to-ship, 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 | 161.950 |
| 2028 (ASM 2) | 162.000 | 162.000 |
| 24/84/25/85 (VDE 1) | 100 kHz channel, lower legs (VDE 1 A) merged, ship-to-shore | 100 kHz channel, upper legs (VDE 1 B) merged, shore-to-ship, ship-to-ship |
| 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) |
| 24/84/25/85/26/86 | 150 kHz channel, ship-to-satellite | 150 kHz channel, satellite-to-ship |
| 24 - 85 | see above | see above |
| 26 | 157.300 (1026) | 161.900 (2026) |
| 86 | 157.325 (1086) | 161.925 (2086) |

## VHF Data Exchange System Functions and Frequency Usage Engineer’s Perspective

The VDES functions and frequency usage from an engineer’s perspective are illustrated pictorially in Figure [3](#fig:VHF_data_exchange_system_functions_and_frequency_usage).

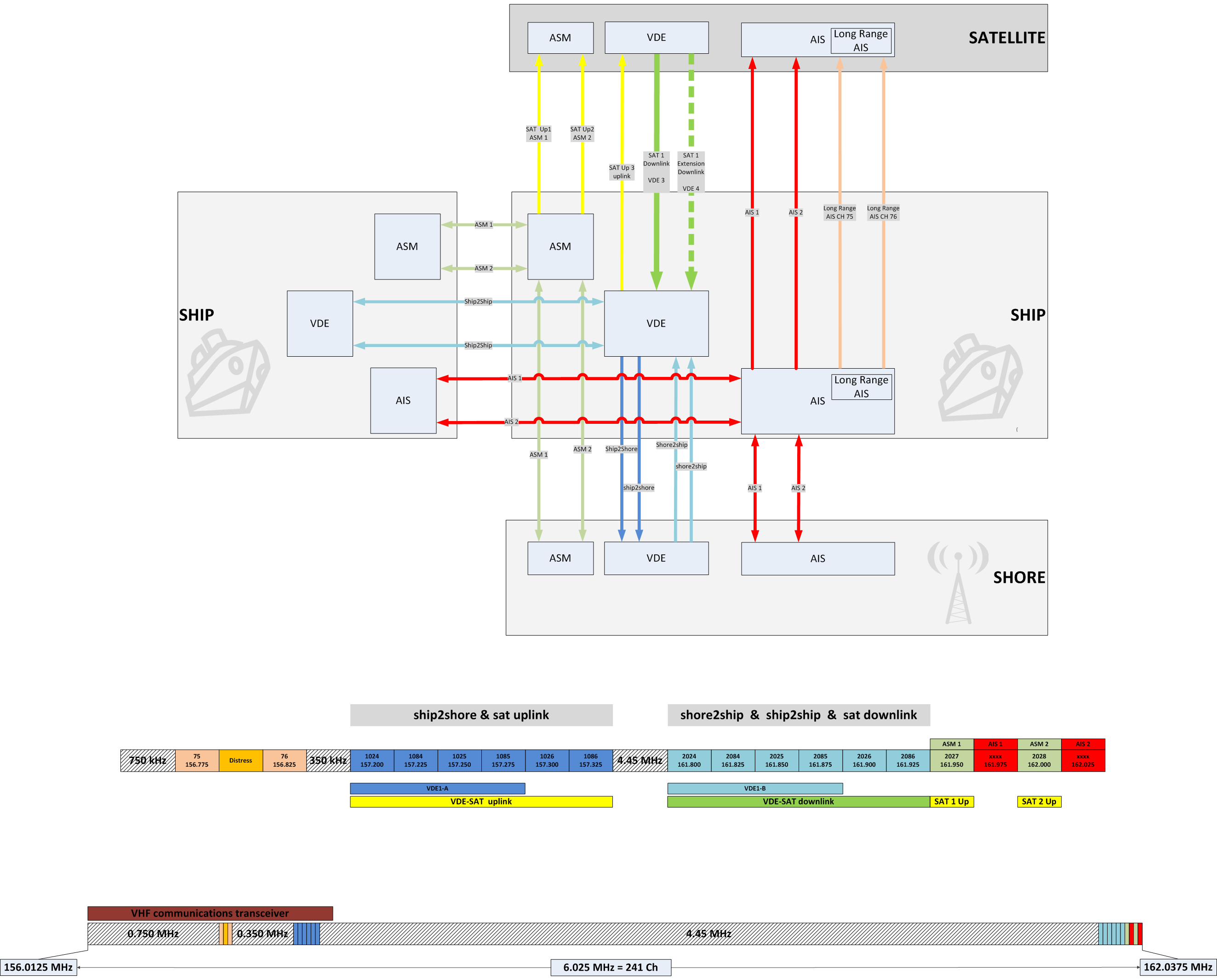


Figure 3: VHF data exchange system functions and frequency usage engineer’s perspective