

VHF Data Exchange System (VDES)

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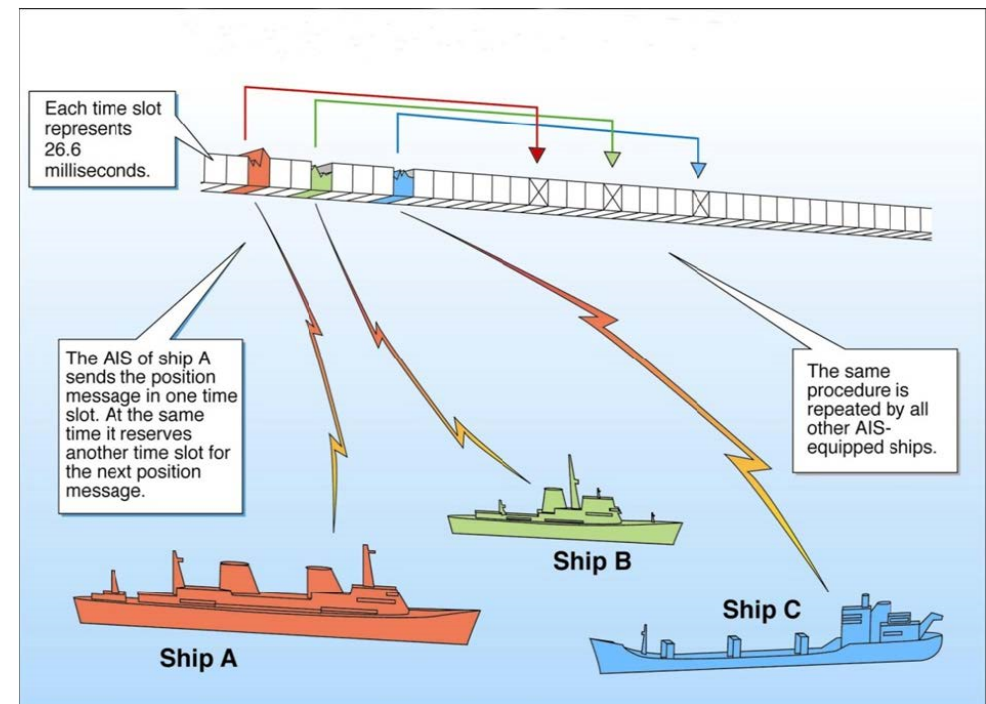
JAPAN COAST GUARD

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Automatic Identification System (AIS)

Technical characteristics

- Frequencies : 2 VHF channels
AIS1 (161.975 MHz/Ch87)
AIS2 (162.025 MHz/Ch88)
- Modulation: GMSK
- Access: Time division multiple access
SO, CS, FA, RA, I
2,250 slots/min/channel
1 slot = 256 bits
- Rate: 9,600 bps



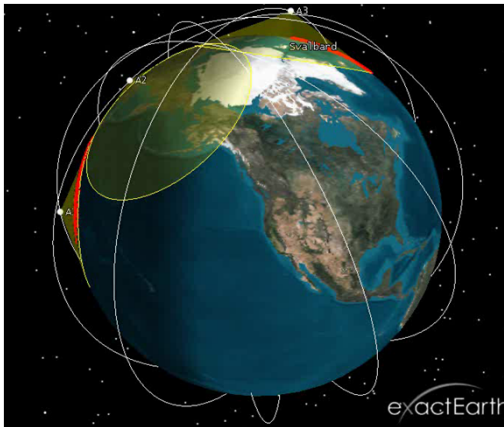
AIS stations

AIS Station (MMSI format)	
Class A AIS (MIDxxxxxx)	Class A stations are shipborne units which meet and are required on most commercial ships by the IMO.
Class B AIS (MIDxxxxxx)	Class B stations are also shipborne units which are mainly compatible and very similar with AIS Class A but do not meet IMO technical or carriage.
AIS base station (00MIDxxxx)	Base stations are designed for use by Competent authorities to manage the VDL and enable effective ship to shore / shore to ship transmission of information.
AIS Aids to Navigation (99MIDxxxx)	AIS AtoN stations extend the visual or audible range of a traditional aid and provide current position or status; or they can provide 'aid' where a traditional aid does not yet exist, known as a virtual AtoN.
AIS on Search and Rescue (SAR) Aircraft (111MIDxxx)	AIS provides for a unique message intended for use by Search and Rescue Aircraft and to assist others in a SAR operation.

AIS stations

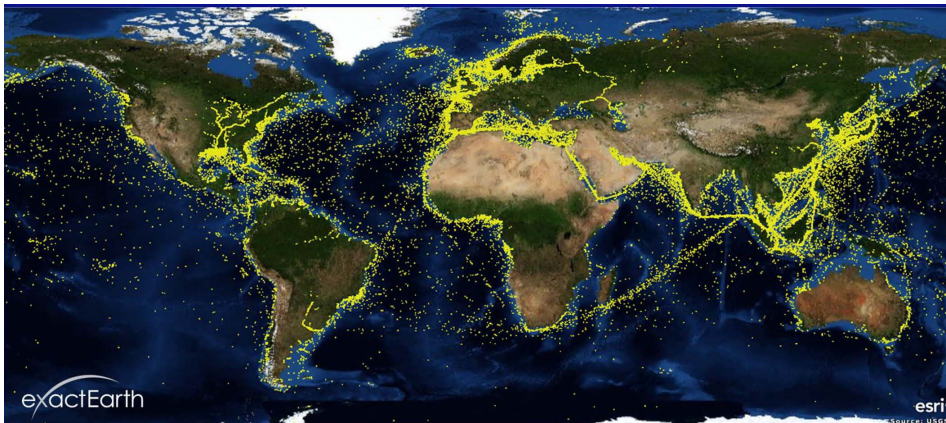
AIS-SART (970YYxxxx)	Search and Rescue Transmitters (SART) are part of the Global Maritime Distress and Safety System (GMDSS). AIS Search and Rescue Transmitters (AIS-SARTs) can be used in lieu of radar SART. AIS-SARTs provide much greater range than radar SART.
MOB-AIS (972YYxxxx)	Man Overboard AIS Transmitters operate in a similar manner to the AIS-SART, but are used to indicate the position of an individual in the water.
EPIRB-AIS (974YYxxxx)	Emergency Position Indicating Radio Beacons are part of the GMDSS and are based on a 406 MHz satellite detectable signal. An EPIRB-AIS also transmits an AIS message to assist with locating, and a 121.5 MHz signal to assist with homing.
AIS Repeater (00MID4xxx)	A station that repeats all non-system management messages to increase the range of the AIS VDL.

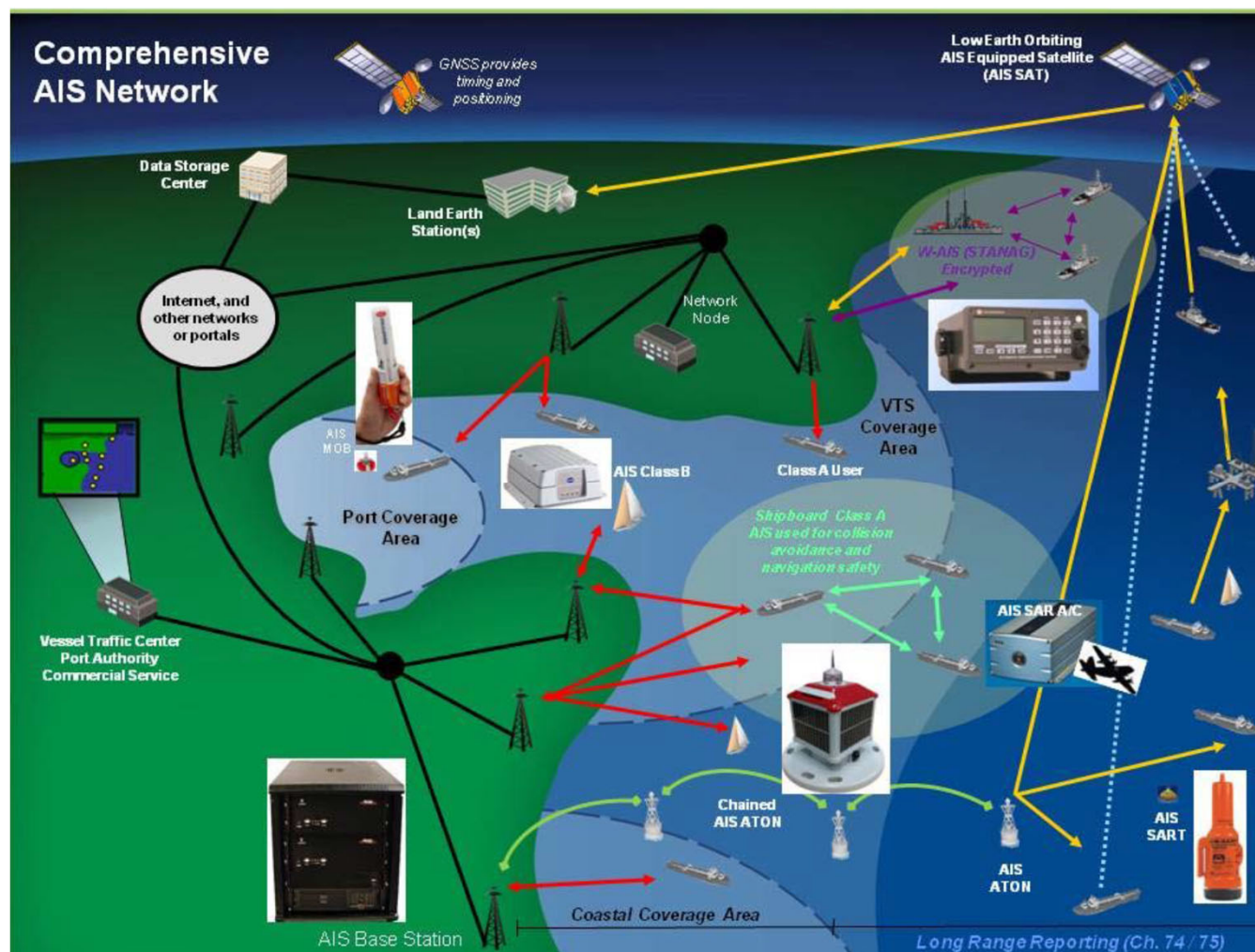
Satellite AIS



Satellite AIS is capable of receiving shipborne AIS today on existing frequencies. However, since these frequencies are shared with fixed and mobile stations, its ability to do so is affected by the very wide footprint of the satellite and the number of stations (fixed and mobile) within the footprint. In order to improve the detection rate, the following measures are adopted.

- Dedicated frequencies: Ch. 75 & 76
- Dedicated message: Message 27





AIS Messages

Message ID	Name	Description
1	Position report	Scheduled position report
2	Position report	Assigned scheduled position report
3	Position report	Special position report, response to interrogation
4	Base station report	Position, UTC, date and current slot number of base station
5	Static and voyage related data	Scheduled static and voyage related vessel data report
6	Binary addressed message	Binary data for addressed communication
7	Binary acknowledgement	Acknowledgement of received addressed binary data
8	Binary broadcast message	Binary data for broadcast communication
9	Standard SAR aircraft position report	Position report for airborne stations involved in SAR operations, only
10	UTC / date inquiry	Request UTC and date
11	UTC / date response	Current UTC and date if available

AIS Messages

Message ID	Name	Description
12	Safety related addressed text message	Safety related data for addressed communication
13	Safety related acknowledgement	Acknowledgement of received addressed safety related message
14	Safety related broadcast text message	Safety related data for broadcast communication
15	Interrogation	Request for a specific message type
16	Assignment mode command	Assignment of a specific reporting behavior by competent authority using a base station to a single mobile station
17	DGNSS broadcast binary message	DGNSS corrections provided by a base station
18	Standard Class B equipment position report	Standard position report for Class B shipborne mobile equipment to be used instead of Messages 1, 2, 3
19	Extended Class B equipment position report	Extended position report for class B shipborne mobile equipment; contains additional static information

AIS Messages

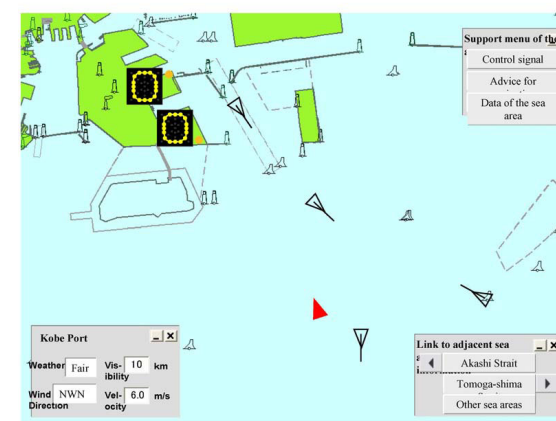
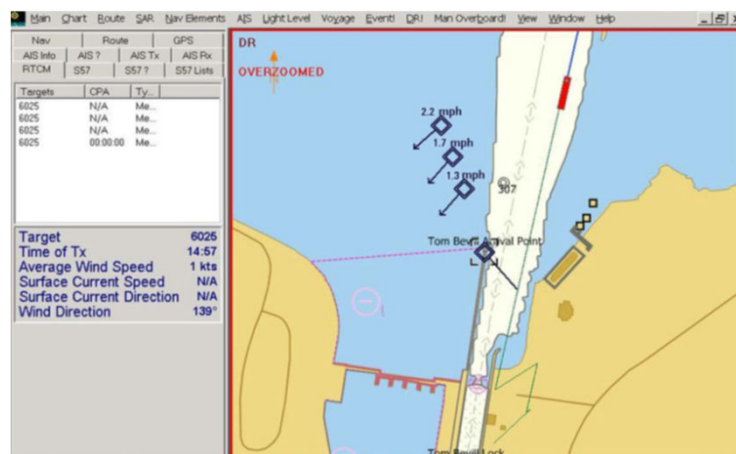
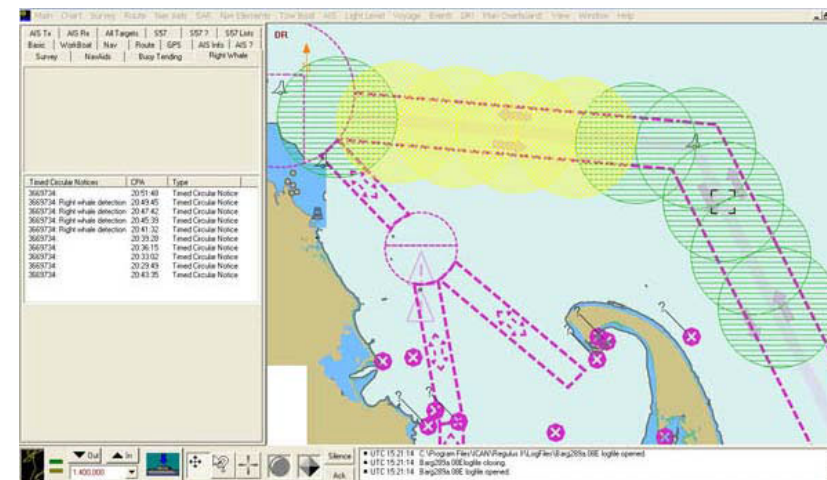
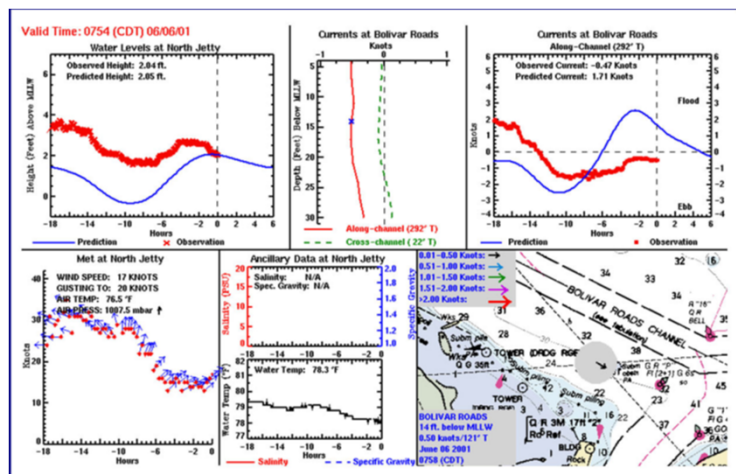
Message ID	Name	Description
20	Data link management message	Used by base station(s) to reserve slots
21	Aids-to-navigation report	Position and status report for aids-to-navigation
22	Channel management	Management of channels and transceiver modes by a base station
23	Group assignment command	Assignment of a specific reporting behavior by competent authority using a base station to a specific group of mobiles
24	Static data report	Additional data assigned to an MMSI Part A: Name;(for any AIS station) Part B: Static Data (for Class B Shipborne mobile)
25	Single slot binary message	Short unscheduled binary data transmission
26	Multiple slot binary message with Communications State	Scheduled binary data transmission
27	Long-range AIS broadcast message	Scheduled position report designed for satellite detection

Application specific message (ASM)

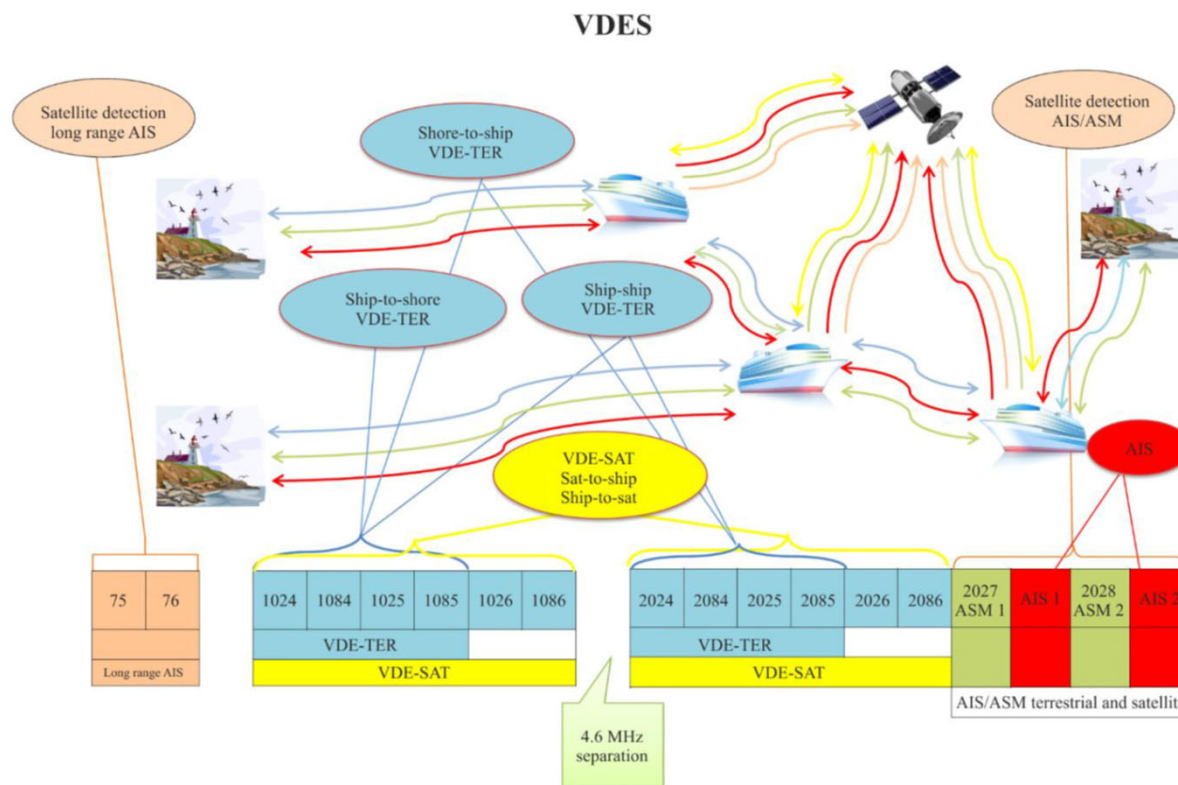
Messages 6, 8, 25 and 26 provide a structure which can accommodate data suited for a specific application (e.g. meteorological and hydrological data, notifying of dangerous cargo, identifying a zone or a route, indicating pilotage requirements, etc.). There are two types of ASM, international use and regional use. The international ASM is assigned by IMO (SN.1/Circ.289) and the regional ASM is assigned by the authorities. IALA maintains the list of regional ASMs. The following list is the international ASMs.

FI	Message name	FI	Message name
16	Number of persons on board	25	Dangerous cargo indication
17	VTS-generated/synthetic targets	26	Environmental
18	Clearance time to enter port	27	Route information – broadcast
19	Marine traffic signal	28	Route information – addressed
20	Berthing data	29	Text description – broadcast
21	Weather observation report from ship	30	Text description – addressed
22	Area notice – broadcast	31	Meteorological and Hydrographic data
23	Area notice – addressed	32	Tidal window
24	Extended ship static and voyage-related data		

Presentation and display of AIS-ASMs (extract from SN.1/Circ.290)



VHF Data Exchange System (VDES)



Components of VDES

- AIS
- ASM
- VDE terrestrial (VDE-TER)
- VDE satellite (VDE-SAT)

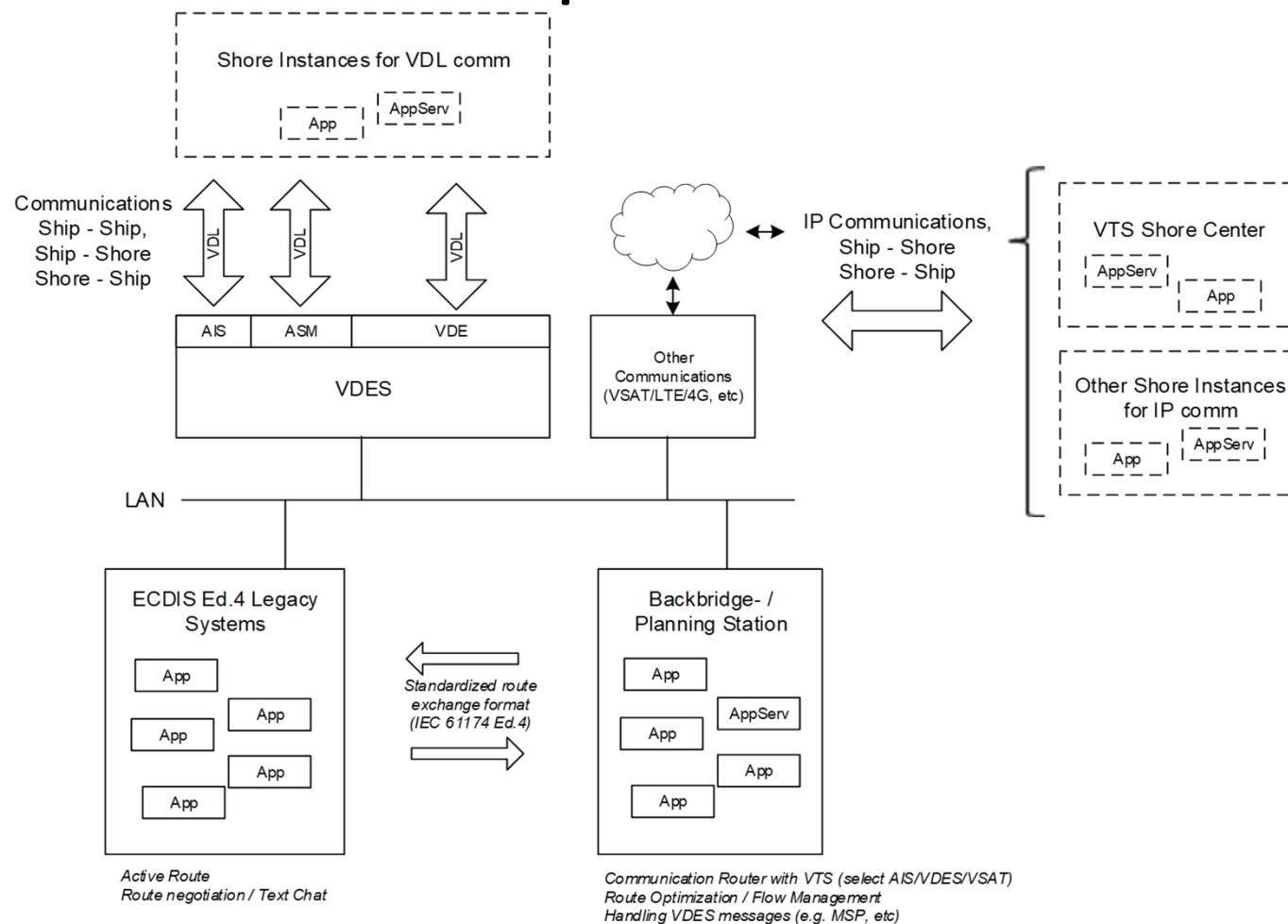
Technical characteristics of VDES

Component	Channels	Bandwidth	Modulation	Rate	Range
AIS	AIS 1, 2 Ch. 75, 76 (long range)	25 kHz	GMSK	9.6 kbps	
ASM	ASM 1 (2027), 2 (2028)	25 kHz	$\pi/4$ QPSK	9.6 ksps	
VDE-TER	1024, 1084, 1025, 1085 2024, 2084, 2025, 2085	25 kHz	$\pi/4$ QPSK 8-PSK 16-QAM	19.2 ksps	
		50 kHz	$\pi/4$ QPSK 8-PSK 16-QAM	38.4 ksps	
		100 kHz	$\pi/4$ QPSK 8-PSK 16-QAM	76.8 ksps	

Technical characteristics of VDES

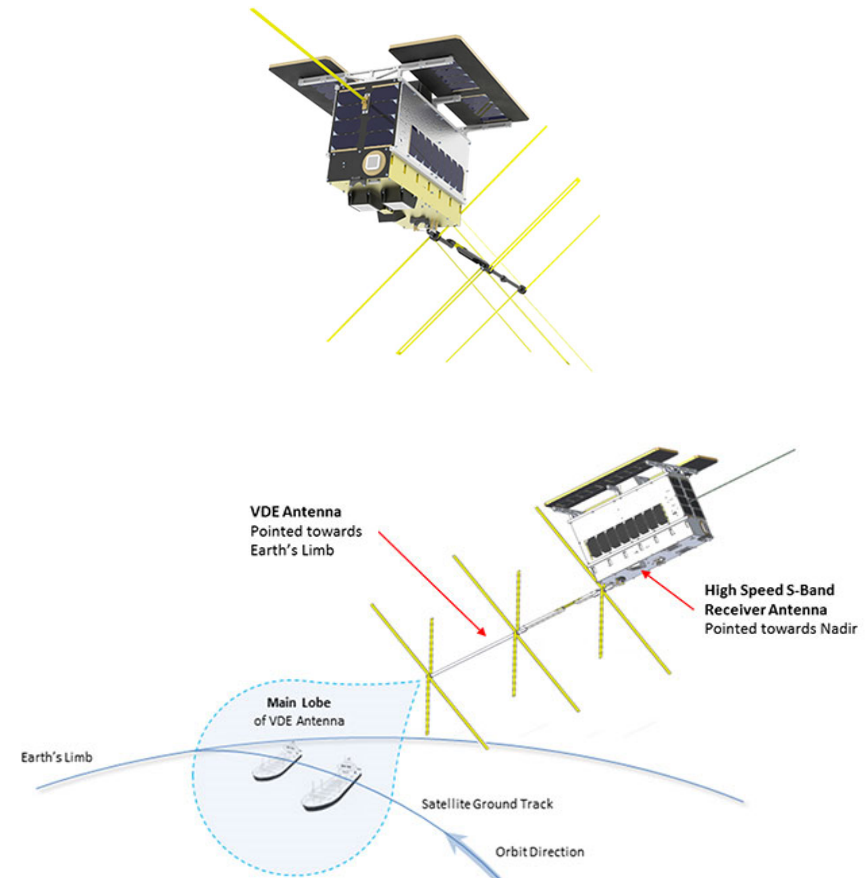
Component	Channels	Bandwidth	Modulation	Rate	Range
VDE-SAT	1024, 1084, 1025, 1085, 1026, 1086 2024, 2084, 2025, 2085, 2026, 2086	Uplink 50 kHz	QPSK/CDMA	2.1 ksps	
		Uplink 50 kHz	$\pi/4$ QPSK 8-PSK 16-QAM	33.6 ksps	
		Downlink 50 kHz	BPSK/CDMA	4.2 ksps	
		Downlink 50 kHz	$\pi/4$ QPSK 8-PSK 16-QAM	33.6 ksps	
		Downlink 100 kHz	BPSK/CDMA	36.0 ksps	
		Downlink 150 kHz	BPSK/CDMA	33.6 ksps	

Concept for VDES



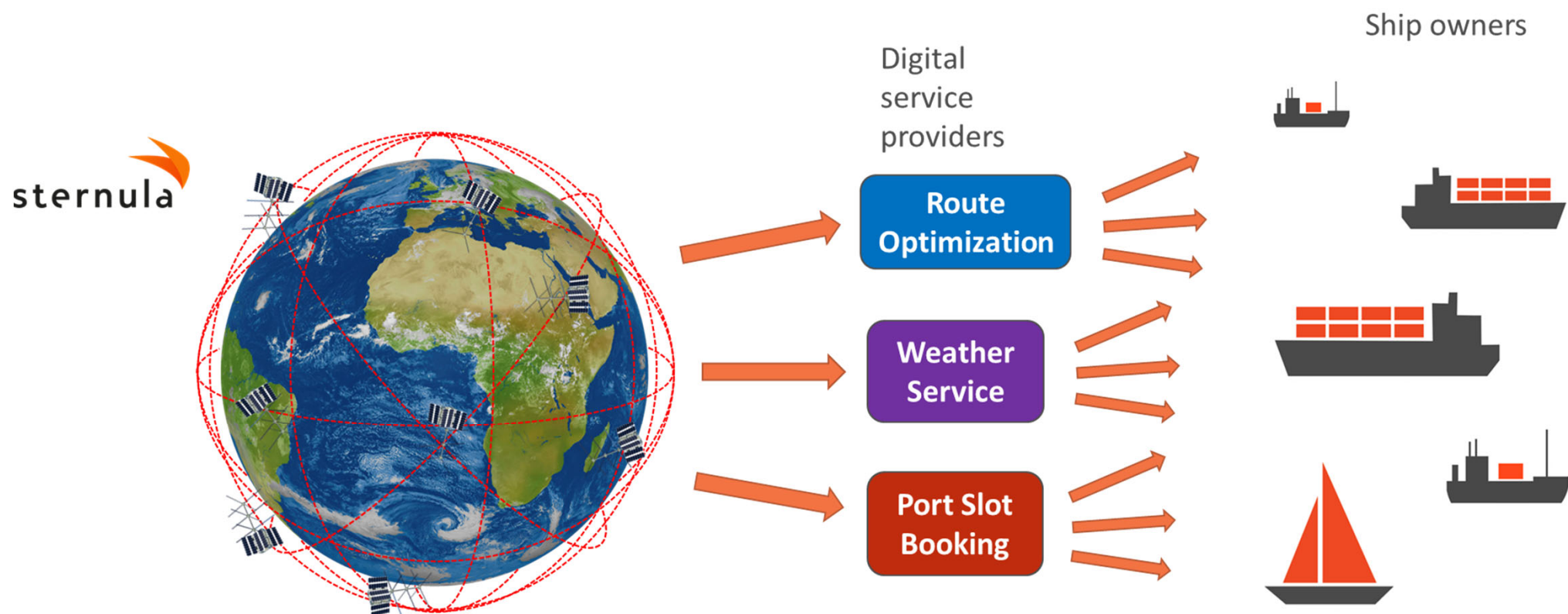
Satellite VDES

- Low Earth Orbit (LEO) satellite
- Range: maximum range is 2,830 km when satellite height is 600 km
- The first test satellite was launched by Norway in 2017
- China and Denmark also launched test satellites
- Commercial service is expected be available by 2030



Satellite VDES

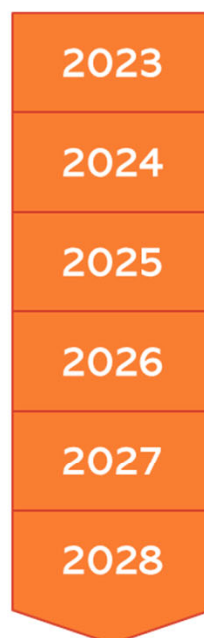
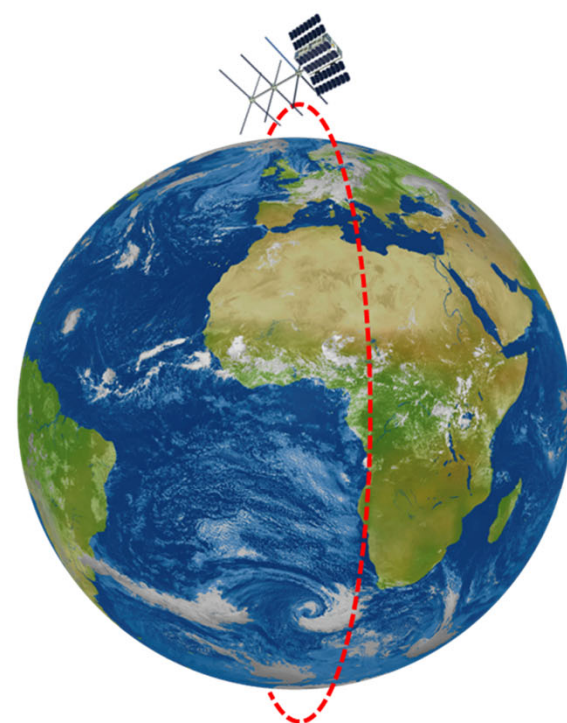
Example of business model (courtesy by sternula)



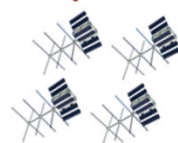
Satellite VDES

Example of satellite network roadmap (courtesy by sternula)

First satellite (G0), January 2023



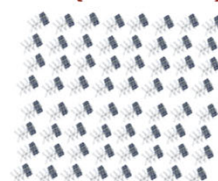
G1 (+4 sat's)



G2 (+16 sat's)

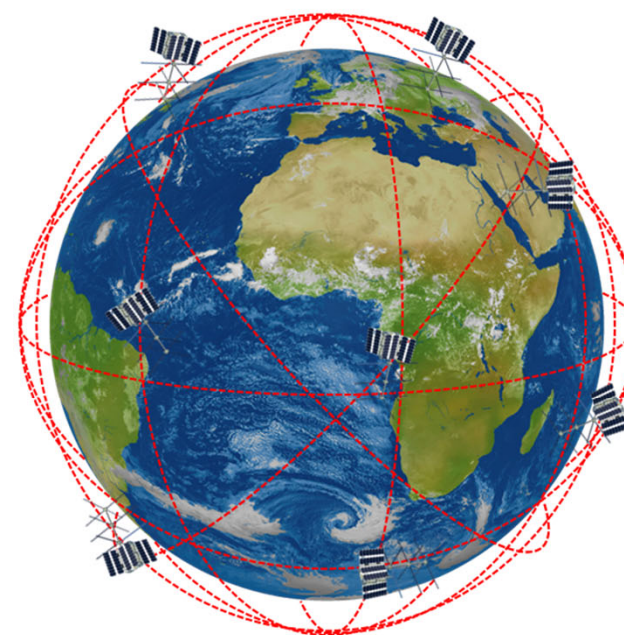


G3 (+40 sat's)



60 satellites by 2028

- Mixed orbits
- Global realtime



Potential VDES uses (IALA's view)

Potential use of VDES	MS in the context of e-navigation
SAR communication	MS 9 – Telemedical Maritime Assistance Service (TMAS) MS 16 – Search and Rescue (SAR) Service
Maritime Safety Information	MS 5 – Maritime Safety Information Service MS 13 – Ice Navigation Service MS 14 – Meteorological Information Service MS 15 – Real-time Hydrographic and Environmental Information Service
Ship Reporting	MS 8 – Vessel Shore Reporting MS 15 – Real-time Hydrographic and Environmental Information Service
Vessel Traffic Services	MS 1 – Vessel Traffic Service (VTS) MS 4 – Local Port Service (LPS) MS 6 – Pilotage Service MS 7 – Tugs Service
Charts and Publications	MS 11 – Nautical Chart Service MS 12 – Nautical Publication Service MS 15 – Real-time Hydrographic and Environmental Information Service MS 2 – Aids to Navigation Service (AtoN)

Potential VDES uses (IALA's view)

Potential use of VDES	MS in the context of e-navigation
Route Exchange	MS 1 – Vessel Traffic Service (VTS) MS 4 – Local Port Service (LPS) MS 5 – Maritime Safety Information (MSI) Service MS 6 – Pilotage Service MS 7 – Tugs Service MS 8 – Vessel Shore Reporting MS 10 – Maritime Assistance Service (MAS) MS 11 – Nautical Chart Service MS 12 – Nautical Publication Service MS 13 – Ice Navigation Service MS 14 – Meteorological Information Service MS 15 – Real-time Hydrographic and Environmental Information Service MS 16 – Search and Rescue (SAR) Service
Logistics	MS 7 – Tugs Service

Other uses: PNT, Message forwarding, VMS, MASS, MDA, Disaster response

IMO Movement on VDES

- MSC94 (2014): Finalized e-navigation strategic implementation plan that included VDES as example of key enablers of e-navigation
- MSC102 (2020): Japan, Norway and Singapore submitted a new output on amendments to SOLAS Chapter V and development and revision of relevant IMO instruments to introduce VDES
- MSC103 (2021): The new output was agreed but not only SOLAS Chapter V but also Chapter IV
- NCSR10 (2023): Development of amendments to SOLAS chapters IV and V and performance standards and guidelines to introduce VHF data exchange system (VDES) was started and agreed to establish the Correspondence Group to progress the development

Terms of Reference

- undertake a technical, regulatory and operational analysis of VHF data exchange system (VDES) and its communication component
- based on the analysis, develop draft performance standards required for the introduction of VDES into the SOLAS Convention
- prepare draft amendments to SOLAS chapter V, including consequential amendments, if necessary, to appendix and associated instruments, taking into consideration the possible substitution of the mandatory carriage requirement of AIS by the AIS component of the VDES
- develop draft amendments to SOLAS chapter IV if time permits

Terms of Reference (cont.)

- based on the analysis, identify and develop other relevant instruments, including consequential amendments and appropriate guidance for SOLAS Contracting Governments, shipowners and seafarers for the application of VDES, required for the introduction of VDES into SOLAS. These should not be limited to applications for harmonized worldwide implementation of VDES, especially taking into account the human element, financial implications and the technical specifications of the system
- submit an interim report, containing the draft amendments to the SOLAS Convention, draft performance standards and other preliminary draft relevant instruments, as far as available, to the nineteenth session of Joint IMO/ITU Experts Group (9 to 13 October 2023) for its consideration

Terms of Reference (cont.)

- taking into account the outcome of discussions at the meeting of the Joint IMO/ITU Experts Group, prepare a report, including the draft amendments to the SOLAS Convention, consequential amendments, draft performance standards and other relevant instruments, as far as available, for consideration
- submit a report to NCSR 11

GMDSS

- Global Maritime Distress and Safety System (GMDSS) means a system that performs the functions set out in regulation 4.1.1.

Regulation 4 – Functional requirements

1 Every ship, while at sea, shall be capable of:

.1 performing the GMDSS functions, which are as follows:

.1 transmitting ship-to-shore distress alerts by at least two separate and independent means, each using a different radiocommunication service;

.2 receiving shore-to-ship distress alert relays;

.3 transmitting and receiving ship-to-ship distress alerts;

.4 transmitting and receiving search and rescue coordinating communications;

.5 transmitting and receiving on-scene communications;

.6 transmitting and receiving signals for locating;

.7 receiving MSI;

.8 transmitting and receiving urgency and safety communications; and

.9 transmitting and receiving bridge-to-bridge communications; and

.2 transmitting and receiving general radiocommunications.

GMDSS

Radio Regulations Chapter VII

30.1 § 1 This Chapter contains the provisions for the operational use of the global maritime distress and safety system (GMDSS), whose functional requirements, system elements and equipment carriage requirements are set forth in the International Convention for the Safety of Life at Sea (SOLAS), 1974, as amended. This Chapter also contains provisions for initiating distress, urgency and safety communications by means of radiotelephony on the frequency 156.8 MHz (VHF channel 16).

31.1 § 1 The frequencies to be used for the transmission of distress and safety information under the GMDSS are contained in **Appendix 15**. In addition to the frequencies listed in Appendix 15, ship stations and coast stations should use other appropriate frequencies for the transmission of safety messages and general radiocommunications to and from shore-based radio systems or networks.

GMDSS

Frequency above 30 MHz (VHF/UHF) allocated by Radio Regulations Appendix 15

Frequency (MHz)	Description of usage
121.5	AERO-SAR
123.1	AERO-SAR
156.3	VHF-CH06
156.525	VHF-CH70
156.650	VHF-CH13
156.8	VHF-CH16
161.975	AIS-SART VHF CH AIS 1
162.025	AIS-SART VHF CH AIS 2

Frequency (MHz)	Description of usage
406-406.1	406-EPIRB
1 530-1 544	SAT-COM
1 544-1 545	D&S-OPS
1 621.35- 1 626.5	SAT-COM
1 626.5- 1 645.5	SAT-COM
1 645.5- 1 646.5	D&S-OPS
9 200-9 500	SARTS

There is no frequencies allocated in the Appendix 15 for VDES. Therefore, VDES can not be used in GMDSS.

If VDES is used for the dissemination of MSI, need the inclusion of VDES frequencies in Appendix 15 or the development of mechanism outside of GMDSS.

Thank you very much!

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