AIS (Automatic Identification System)

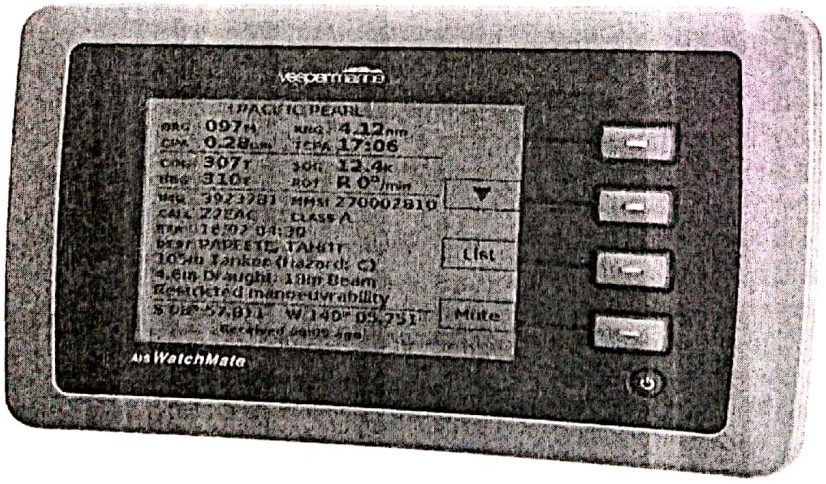
AIS is a transponder system for ships, intending to increase the safety at sea. It operates in the VHF band. The two frequencies used are 161.975 Mhz (send) and 162.025 MHz (RCVD).

Every 2 - 10 seconds, transmits the following data:

- MMSI number
- Navigation status, e.g. 'at anchor' or 'under way'
- Ground speed
- Rate of turn
- Position
- Heading and Course over Ground

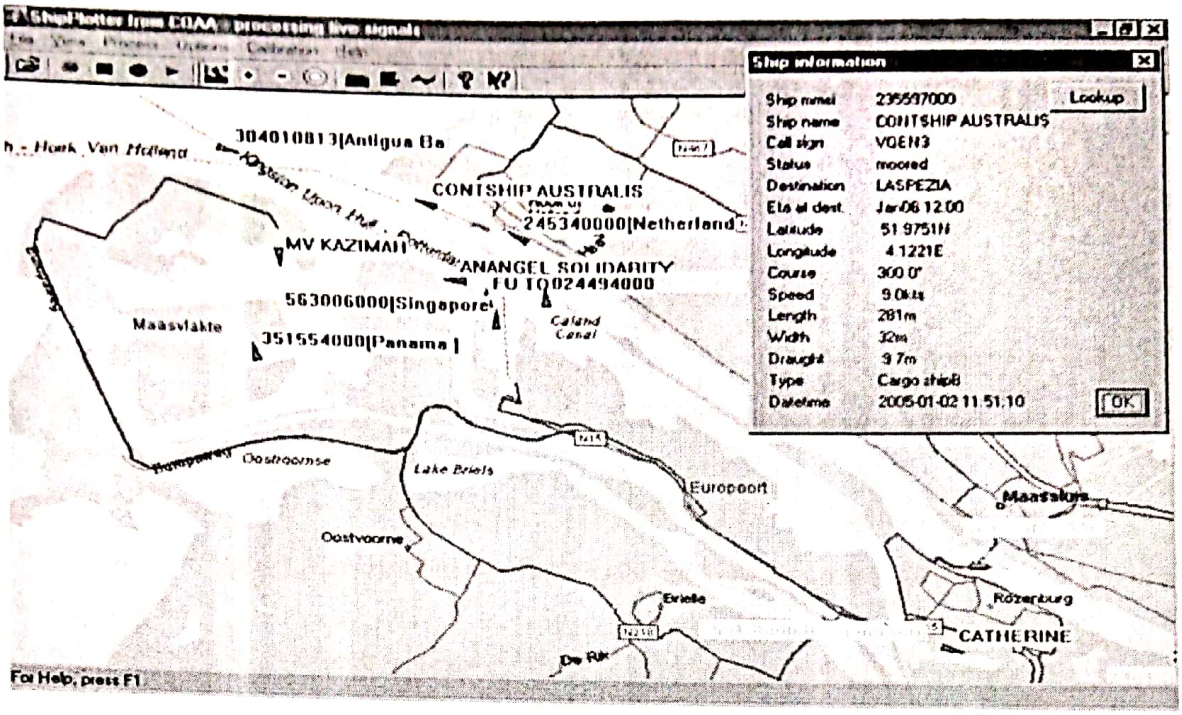
Furthermore, every six minutes the following information is transmitted:

- MMSI number
- IMO number
- Call sign
- Ship's name
- Type of ship or cargo
- Dimensions of the ship
- Draught, 0.1 to 25.5 m
- Destination & ETA



Below we have included a screen copy of Ship Plotter, a **map** of the Rotterdam port area. All ships with AIS in the vicinity are visible. The software draws a trail behind the ship if it is moving.

The system also greatly increases safety at night and AIS signals are received in poor conditions such as heavy rain and squally conditions where a radar may have some limitation.



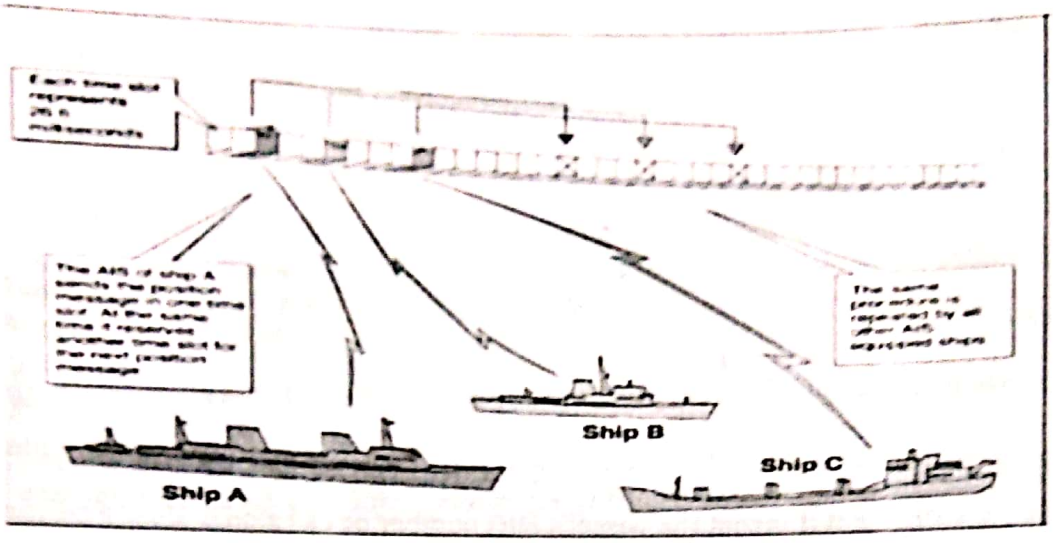
The system coverage range is similar to other VHF applications, essentially depending on the height of the antenna & its connections, Its propagation is slightly better than that of radar, due to the longer wavelength, so it's possible to "see" around bends and behind islands if the land masses are not too high. A typical value to be expected at sea is nominally 20 nautical miles. With the help of repeater stations, the coverage for both ship and VTS stations can be improved considerably.

How Does It Work?

Each AIS system consists of one VHF transmitter, two VHF receivers, one VHF DSC receiver, and a standard marine electronic communications link (IEC 61162/NMEA 0183) to shipboard display and sensor systems. Position and timing information is normally derived from an integral or external global navigation satellite system (e.g. GPS) receiver, including a medium frequency differential GNSS receiver for precise position in coastal and inland waters. Other information broadcast by the AIS, if available, is electronically obtained from shipboard equipment through standard marine data connections.

each station transmits and receives over two radio channels to avoid interference problems, and to allow channels to be shifted without communications loss from other ships.

Each station determines its own transmission schedule (slot), A position report from one AIS station fits into one of 2250 time slots established every 60 seconds. AIS stations continuously synchronize themselves to each other, to avoid overlap of slot transmissions. Slot selection by an AIS station is randomized within a defined interval. when new stations, including those stations which suddenly come within radio range close to other vessels, choose her slot & will always be received by those vessels. In the event of system overload, only targets further away will be subject to drop-out, in order to give preference to nearer targets that are a primary concern to ship operators. In practice, the capacity of the system is nearly unlimited, allowing for a great number of ships to be accommodated at the same time.



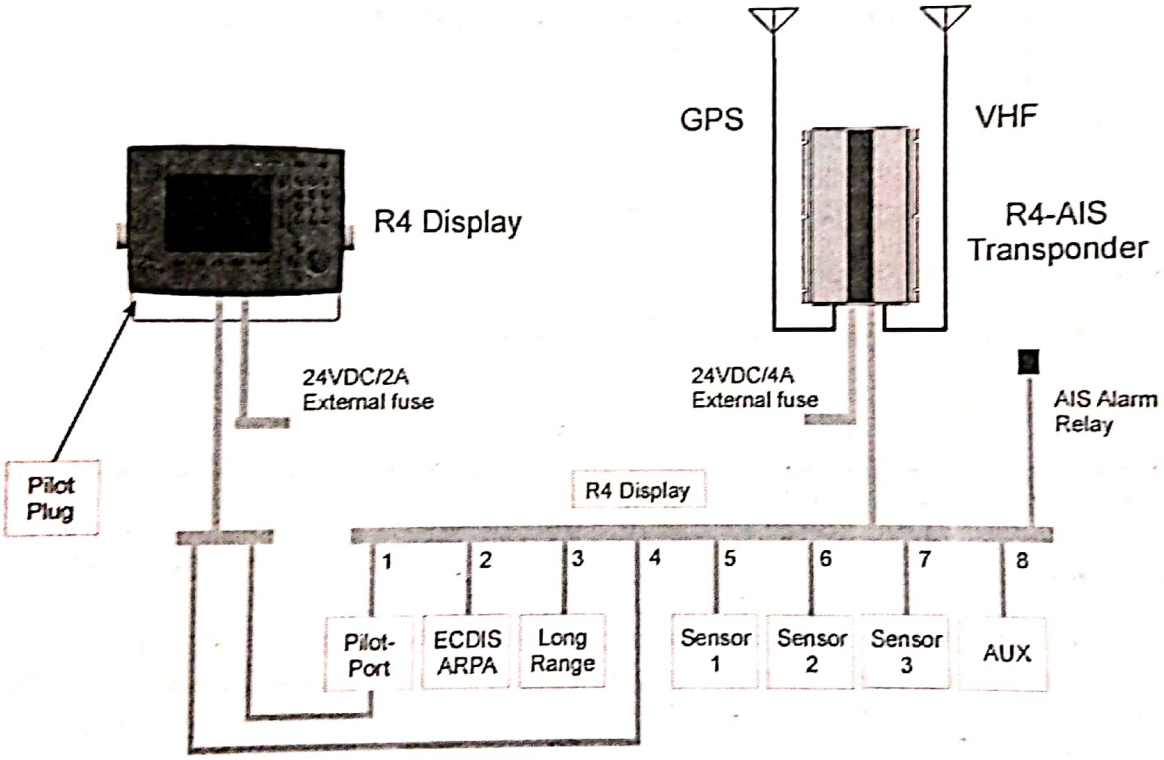


Figure 1: R4-AIS Transponder System overview

Types of AIS

ITU Recommendation M.1371-1 describes the following types of AIS:

Class A

Shipborne mobile equipment intended for vessels meeting the requirements of IMO AIS carriage requirement, and is described above.

Class B

The Class B is nearly identical to the Class A, except the Class B:

- Has a reporting rate less than a Class A (e.g. every 30 sec. when under 14 knots, as opposed to every 10 sec. for Class A)
- Does not transmit the vessel's IMO number or call sign
- Does not transmit ETA or destination
- Does not transmit navigational status
- Is only required to receive, not transmit, text safety messages
- Is only required to receive, not transmit
- Does not transmit rate of turn information
- Does not transmit maximum present static draught

the availability of class B transponders is increasing amongst smaller commercial boats, fishing and work boats and recreational boaters.

Search and Rescue Aircraft

Aircraft mobile equipment, normally reporting every ten seconds.

Aids to Navigation

Shore-based station providing location of an aid to navigation. Normally reports every three minutes. This may eventually replace the racon.

AIS base station.

Shore-based station providing text messages, time synchronization, meteorological or hydrological information, navigation information, or position of other vessels. Normally reports every ten seconds.

Regulations for carriage of AIS

Regulation 19 of SOLAS Chapter V - Carriage requirements for shipborne navigational systems and equipment - sets out navigational equipment to be carried on board ships, according to ship type. In 2000, IMO adopted a new requirement (as part of a revised new chapter V) for all ships to carry automatic identification systems (AISs) capable of providing information about the ship to other ships and to coastal authorities automatically.

The regulation requires AIS to be fitted aboard all ships of 300 gross tonnage and upwards engaged on international voyages, cargo ships of 500 gross tonnage and

upwards not engaged on International voyages and all passenger ships irrespective of size. The requirement became effective for all ships by 31 December 2004.

Ships fitted with AIS shall maintain AIS in operation at all times except where international agreements, rules or standards provide for the protection of navigational information.

A flag State may exempt ships from carrying AISs when ships will be taken permanently out of service within two years after the implementation date. Performance standards for AIS were adopted in 1998.

The regulation requires that AIS shall:

- provide information - including the ship's identity, type, position, course, speed, navigational status and other safety-related information - automatically to appropriately equipped shore stations, other ships and aircraft;
- receive automatically such information from similarly fitted ships; · monitor and track ships;
- exchange data with shore-based facilities.

The AIS Pilot Plug, on each vessel over 1,600 gross tons, on international voyage, shall be available for pilot use, easily accessible from the primary conning position of the vessel, and near 120 volt, AC power, 3-prong receptacle

BENEFITS OF AIS

Automatic Vessel Identification AIS brings to the mariner many benefits. Principal amongst these is sending & receiving vessel identity (MMSI, call sign etc), thereby facilitating rapid radio communication where necessary. This benefit is of equal, if not even greater value to VTS authorities.

a) Wider geographical coverage.
AIS data will be received by other AIS units, or by base or repeater stations. Thus where a VTS organization is fitted with such equipment, it will be capable of receiving both identity and precise location of a vessel at the maximum reception range of the VHF radio communications frequency.

b) Greater positional accuracy.
AIS aims to achieve positional accuracy better than 10 meters when associated with DGNSS correction signals. This compares favorably with radar which positional accuracy in the range 30 to 50 meters. provide the position of floating aids (primarily buoys). possibly to replace radar transponder beacons (RACONS);

c) Absence of "radar shadow" areas.
In coastal and harbor waters radar tracking of vessels can be masked, or otherwise affected by the proximity of land and buildings. Whilst AIS tracks will avoid the great majority of such effects.

d) Traffic image accuracy
Vessel tracking can similarly be interrupted when two vessels pass close to one another, with the result that the radar tracking of one contact is confused by the proximity of the

other. Importantly, this can result in the identity of one track transferring or "swapping" to the other. Self-evidently, such a situation introduces a potentially dangerous inaccuracy in the vessel traffic image, unless noticed and rectified quickly by VTS center.

e) Real time maneuvering data.
Radar based VTS systems will typically provide details of a vessel's course and speed over the ground. In contrast, AIS will provide all recipients with certain elements of real time maneuvering data such as Ships Heading and Rate of Turn.
f) Weather effects on tracking performance.
Navigational radar performance is often adversely affected by precipitation as a function of the radio frequency on which it operates. In heavy rain or snow, effective radar tracking is sometimes unachievable. As a consequence, a VTS center is much more likely to maintain an accurate traffic image in
adverse weather where that tracking is based on AIS data.

g) Provision of more precise navigational advice.
It follows that where a VTS center is able to receive AIS information from vessels within or adjacent to its area, the quality, accuracy and reliability of vessel tracking will be improve. As a consequence, that VTS center will be able to provide more precise navigational advice. Moreover, the availability of certain real time maneuvering data within the VTS center will enable VTS operators to appreciate more rapidly, and in greater detail, actual vessel movement.

h) Electronic transfer of sailing plan information
Where AIS is integrated into a VTS system, it becomes possible for vessels and the VTS center to exchange passage information such as intended way points.

i) Electronic transfer of safety messages.
The facility available within AIS for the transmission of short safety messages makes possible the electronic broadcasting from a VTS center of local navigation warnings, and similar safety related messages.
VTS center may have the capability to broadcast via AIS local chart corrections to ECDIS fitted ships.
Vessels are normally required to report to the VTS authority that any dangerous goods are being carried.
j)Impact on VHF communications
one of major benefit of AIS is the consequential reduction of VHF voice messages. This in turn reduces the reliance placed on vessels understanding such messages from a VTS center and vice versa.
k)Archiving data
The automatic availability within a VTS center of AIS data for each vessel facilitates the rapid and comprehensive recording, replay and archiving of data

l)Improved SAR management
Many marine and VTS authorities are equipping SAR capable units, including aircraft and helicopters, with AIS. The AIS voyage related message permits a vessel to transmit the number of persons onboard. Whilst this is not mandatory for vessels at sea, it can be made a formal requirement in a VTS area. The provision of such details, and the ready identification and location of SAR units greatly facilitates the management and evaluation of any SAR response.

m)binary messages

for transmission of Specific Messages as a means for certain types of limited communications between ship & shore station. For example:

- ships to report information to other ships and shore stations;
- shore stations to report navigation information, conditions and warnings

n) AIS for Meteorological information

The information to be broadcast will depend on the operational requirement and the availability of measuring and processing equipment. Examples include:
· Wind speed, average and gust values
· Wind direction
· Water level
· Water temperature
· Air temperature
· Current speed and direction at different depths
· Tide information
Such data permits the presentation of real time information at receiving stations, including onboard ships within VHF range.

LIMITATIONS ASSOCIATED WITH USE OF AIS

Although AIS has the potential to greatly enhance VTS operations, the system does have several limitations:
· VTS operators may become overly dependent on AIS and, therefore, may treat the system as a sole or primary means for vessel identification; as a result, they may fail to identify contacts, because all vessels may not be equipped with AIS;
· AIS has the same limitations as VHF-FM;
· When a AIS unit reaches its saturation point (maximum number of transmission receipts), accepting those closest to the unit and eliminating those furthest away, a feature particularly useful to ships, however, this feature could prove detrimental to VTS operations that must service a large area this can, however be overcome by better coverage through the addition of more base stations and/or repeaters.
· Whilst AIS tracks will avoid the great majority of radar shadow effects, the very close proximity of buildings and bridges, can degrade the AIS positional information.

Bridge Arrangement

1) Minimum Keyboard and Display

The functionality of the. Minimum Keyboard and Display (MKD). shall be available to the mariner at the position from which the ship is normally operated. internal MKD (integrated or remote) or through the equivalent functionality on a separate display system.

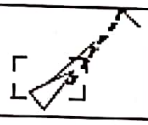
2)Pilot plug
A pilot input/output port is part of an AIS Class A station. A plug connected to this port should be installed on the bridge near the pilots operating position so that a pilot can connect a Personal Pilot Unit (PPU).

3)Display system

If there is navigational equipment capable of processing and displaying AIS information such as ECDIS, ARPA.

4) alarm output

The AIS requires that an alarm output (relay) be connected to an audible alarm device or the ships alarm system.

AIS target	Symbol	Description of symbol
AIS target (sleeping)		An isosceles, acute-angled triangle should be used with its centroid representing the target's reference position. The most acute apex of the triangle should be aligned with the heading of the target, or with its COG, if heading information is not available. The symbol of the sleeping target may be smaller than that of the activated target.
Activated AIS target		An isosceles, acute-angled triangle should be used with its centroid representing the target's reference position. The most acute apex of the triangle should be aligned with the heading of the target, or with its COG, if heading information is not available. The COG/SOG vector should be displayed as dashed line starting at the centroid of the triangle The heading should be displayed as solid line of fixed length starting at the apex of the triangle A flag on the heading indicates a turn and its direction in order to detect a target manoeuvre without delay A path predictor may also be provided
Selected target		A square indicated by its corners should be drawn around the target symbol.
Dangerous target		A bold line clearly distinguishable from the standard lines should be used to draw the symbol. The size of the symbol may be increased. The target should be displayed with: vector, heading and rate of turn indication. The symbol should flash until acknowledged. The triangle should be red on colour displays.
Lost target		A prominent solid line across the symbol, perpendicular to the last orientation of the symbol should be used. The symbol should flash until acknowledged. The target should be displayed without vector, heading and rate of turn indication.

Information shown by AIS divided in to 2 types:

Dynamic data input

1. External Sensors
2. Position
3. Heading
4. Rate of Turn

5. Speed and Course If a bottom track (BT)-log for speed over the ground (SOG) is available, it may be connected.
6. Navigational Status: A simplified means should be provided for the operator to input the ships navigational status e.g. underway using engine, at anchor, not under command, restricted in ability to maneuver.

Static Information

The AIS standards require that certain static, voyage-related, information be entered manually, normally by means of the MKD,

- Maritime Mobile Service Identity (MMSI) number
- IMO vessel number
- Radio call sign
- Name of ship
- Type of ship
- Dimension of the ship.

voyage related data:

- ships draft
- destination
- eta
- type of cargo
- number of crew onboard

Long-Range function

The AIS. long-range function needs a compatible long-range communication system (e.g. Inmarsat-C or MF/HF radio as part of GMDSS).
If this is available, a connection between that communication system and the Class A mobile unit can be made. This connection is needed to activate the LR function of AIS.

AIS & COLREG:

As per COLREGS requirement that the Officer Of the Watch (OOW) should use "all available means", it is a clear indication that IMO intended the AIS to be used to avoid collision.
However, a word of caution should be included: the guidelines also warn that the mariner should not rely on AIS alone, and should not use the AIS as an excuse to slacken his lookout or responsibility. This statement agrees fully with COLREGS requirements for good seamanship and proper look-out. Possibly the reader should also be aware that, in interpreting AIS data by ECDIS systems, the good practice is to use the target positions only and not trust the SOG (Speed Over Ground) and COG (Course Over Ground) computed and sent by the target's AIS transmitter. Those parameters are calculated separately using ARPA systems.

Use of AIS in oil terminals

The AIS operates on a VHF frequency and transmits and receives information automatically, and the output power ranges between 2 and 12.5 watts.
When alongside a terminal or port area where hydrocarbon gases may be present, either the AIS should be switched off or the aerial isolated.
When alongside a terminal or port areas where no hydrocarbon gases are likely to be present, and if the unit has the facility, the AIS should be switched to low power.

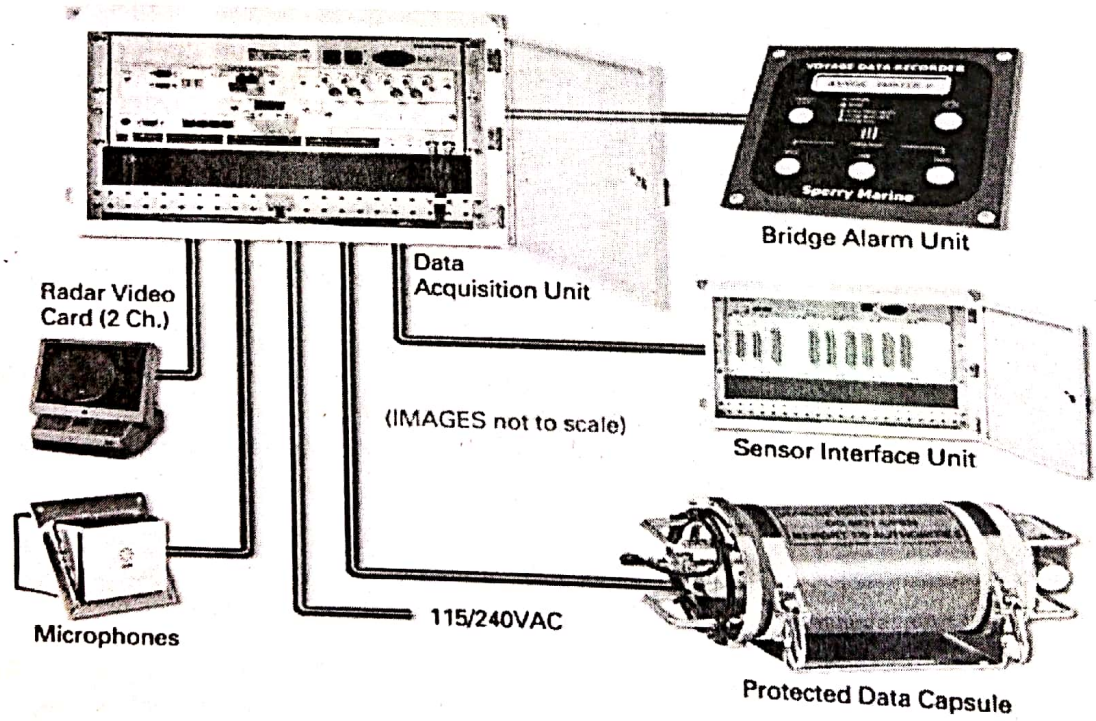
VDR

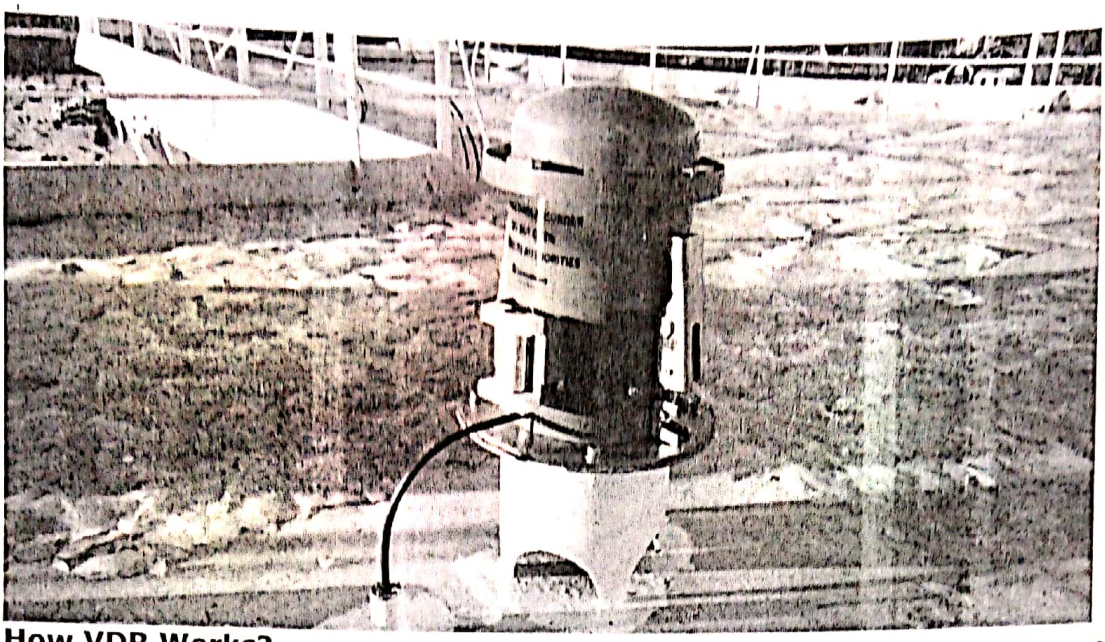
What is VDR?

A VDR or voyage data recorder is an instrument safely installed on a ship to continuously record vital information related to the operation of a vessel. This recording is recovered and made use of for investigation in events of accidents.

A ship's VDR is far superior to a black box of an aero plane as it store variety of data.

A VDR is capable of withstanding heavy weather, collisions, fires and pressure conditions even when a ship is at a depth of several meters in water.





How VDR Works?

The purpose of a Voyage Data Recorder is to store information in a secure and retrievable form, relating to the position, movement, physical status, command and control of a ship over the period and following an incident. Information contained in a VDR should be made available to both the authorities and the ship-owner. This information will be required during any subsequent safety investigation to identify the cause(s) of the incident

There are various sensors placed on bridge of the ship and on prominent location from which the required data is continuously collected.

There is also a record button provided in the bridge unit so that after pushing button (say during starting of any incident like collision or grounding), the recorder will start recording new set of information from that period of time.

The collected data by VDR is digitalized, compressed, and is stored in a protective storage units which is mounted in a safe place. This temper proof storage unit can be a retrievable fixed & floating unit connected with EPIRB for early location in the event of accident. In floating type, a hydrostatic release unit is fitted which will be active when ship skunked and detached from vessel & float in sea level.

The VDR at least must record the following:

- Date and time (SVDR)
- Ship's position (SVDR)
- Speed and heading (SVDR)
- Bridge audio (SVDR)
- Communication audio (radio) (SVDR)
- Radar data (SVDR)
- ECDIS data (SVDR)
- Echo sounder
- Main alarms
- Rudder order and response
- Hull opening (doors) status
- Watertight and fire door status
- Speed and acceleration
- Hull stresses

- Wind speed and direction

Regulatory requirements for carrying VDR

The requirement for carrying VDR under IMO came into force on 1st July 2002 for all the passenger ships constructed after 1st July 2002 and vessel other than passenger ship above 3000 GT as per SOLAS Chapter V.

On December 2004, an amendment was adopted for above regulation for carrying simplified voyage data recorder or S-VDR and it entered into force on 1st July 2006.

A S-VDR is a simple data recorder which stores less but vital data as compared to a standard VDR; however, the storage criteria is same.

In May 2012 the Maritime Safety Committee of IMO (International Maritime Organization) adopted a revised recommendation on performance standards for voyage data recorders (VDRs), to be enforced by 1 July 2014.

New requirements defined in MSC.333(90):

- Data shall be recorded in a fixed capsule, a float-free capsule and internally in the VDR
- Data shall be recorded for minimum 48 hours in both capsules and 30 days internally in the VDR
- Bridge audio shall be recorded using at least two tracks for indoor microphones. Outdoor microphones (where applicable) shall be recorded on an additional separate track. The current standard is not very specific regarding this. The new standard also specifies that audible alarms and noise on the vessel shall not prevent the VDR from recording audio properly
- Images, chart(s) used and settings from the ECDIS shall be recorded. Images from both radars on the vessel shall be recorded
- Data from the AIS shall be recorded.
- Data from an inclinometer shall be recoded if installed.