COURSE 4
NAVAL COMMUNICATION SYSTEMS

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CONTENT

- ❑ VHF communications

- ❑ Navtex

- ❑ DSC

- ❑ GMDSS

- ❑ E-Navigation

VHF

❑ It is a two-way voice communication system used between ships and communication with shore equipment or in certain circumstances with airplanes

○ It was the first radio system used for maritime communications since 1900

❑ FM channels in the 156-174MHz frequency band (ITU-T: VHF maritime broadband) are used

❑ The transmission power is limited to 25W

❑ The coverage radius is 100km

○ For longer distances HF (2.31-25.82MHz) or maritime MF (1.6-2.85MHz) can be used

▪ The US Coast Guard uses the frequency of 2670kHz

❑ It is used for ships at the sea, rivers and lakes

VHF

❑ Initially, channels 1-28 with 50kHz spacing were defined

- o Subsequently channels 60-88 with 25kHz spacing inserted between the original channels, were introduced
- o Channel 16 (156.8MHz) is used only for emergencies and is constantly monitored

❑ Half-duplex transmissions are mainly used

- o The equipment is configured for reception
- o If a message needs to be transmitted, a button needs to be pushed (push-to-talk)
- o There are channels that allow full-duplex transmissions using frequency pairs

❑ There is a standard language based on the English language to be used (e.g. NATO Phonetic Alphabet, SMCP – Standard Marine Communication Phrases)

NAVTEX

❑ Navtex (Navigational telex) is an MF service for the transmission of navigation, weather and MSI information (Maritime Safety Information)

❑ The transmission range is 370 km from the shore

❑ Navtex broadcast messages are transmitted on the 518 and 490kHz frequencies

❑ The international Navtex frequency is 518kHz

❑ It uses BFSK at 100bps
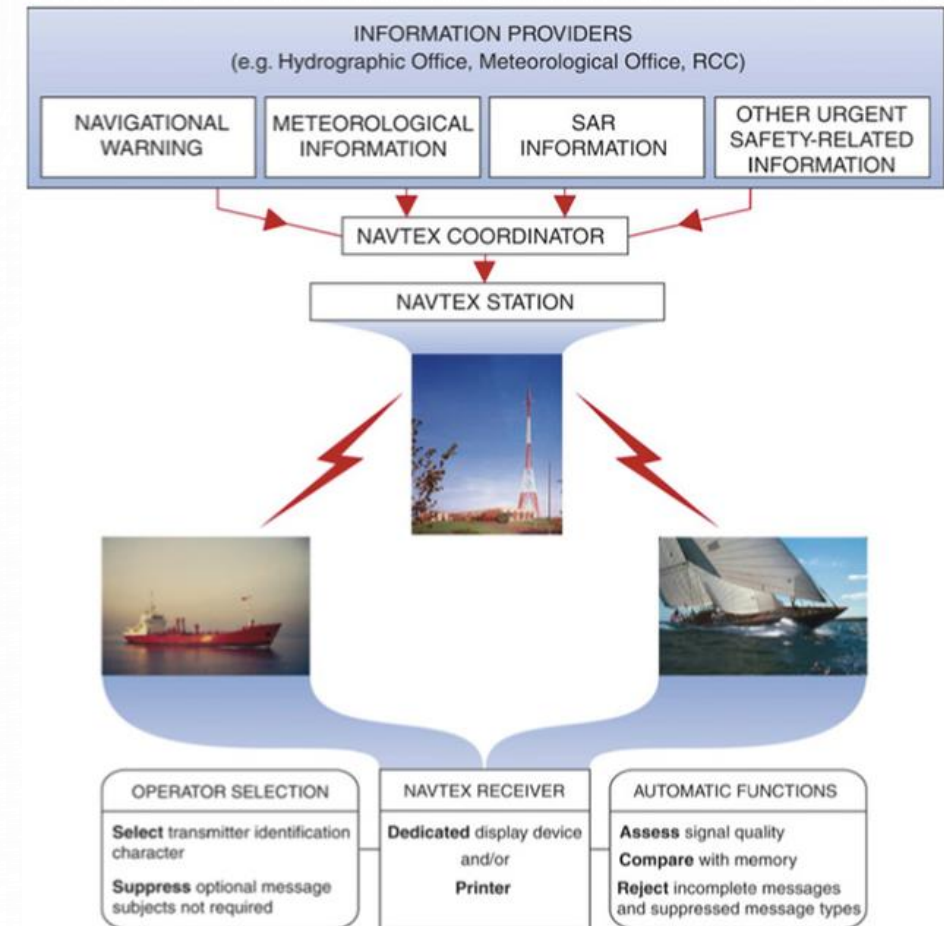
NAVTEX

❑ A Navtex message consists of:

- ”ZCZC” characters
- The characters
  - B1 – transmitter ID
  - B2 – message subject indicator
  - B3, B4 – message serial number
- Information
- ”NNNN” characters


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ZCZC JA42
141600 UTC OCT
GERMAN NAV WARNING 663
WESTERN BALTIC. MARKGRAFENHEIDE AND 'BALTIC 1' OFFSHORE WIND FARM.
UNDERWATER OPERATIONS IN PROGRESS
BY 'BALTIC TAUCHER 2/DECT2'
ALONG SUBMARINE POWER CABLE
54-12N 012-08E AND
54-37N 012-38E.
BERTH OF 0.5 NM REQUESTED.
NNNN
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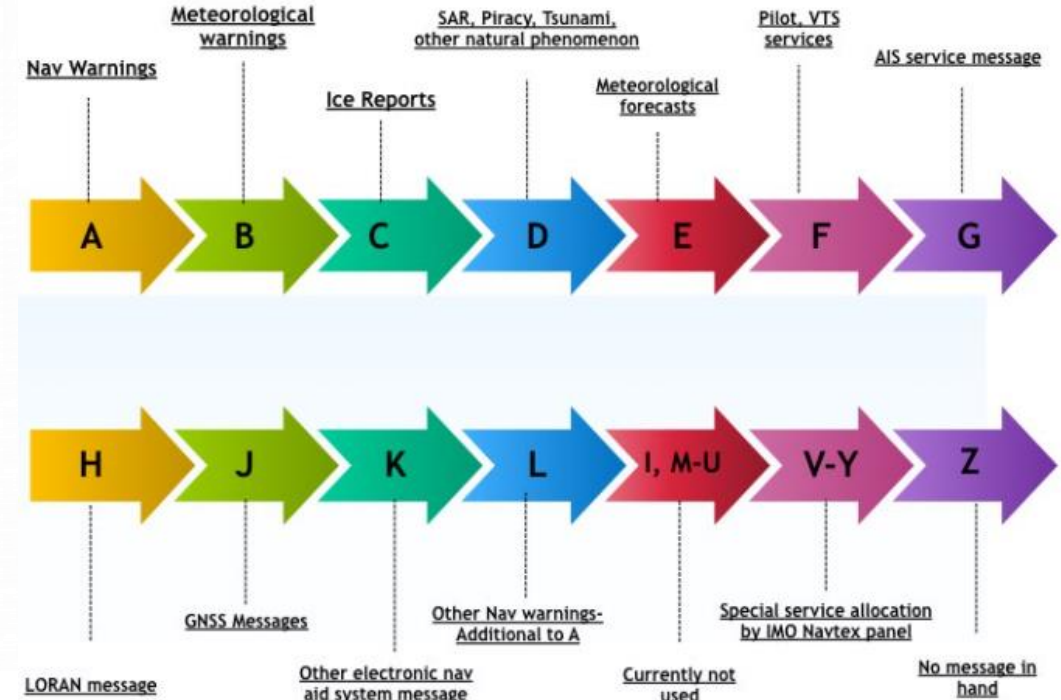
DSC

❑ DSC (Digital Selective Calling) in addition to voice services allows:

  o Calling another ship using MMSI (Maritime Mobile Service Identity)

    ▪ The VHF channel 70 is used

  o Emergency button, which automatically transmits a signal identifying the ship and the nature of the emergency

  o Bult-in on externally connected GPS receiver for transmitting the location with the emergency call

❑ It is a synchronous system that uses characters composing a 10-bit error detector code

❑ FSK is used

❑ For VHF the frequencies of the two tones are 1.3 and 2.1MHz with a symbol rate of 1200 Baud

AIS

❑ AIS (Automatic Identification System) – transmits information about location, MMSI, destination, etc. to other ships around

❑ AIS operates as a mesh network

  o AIS units can relay received messages, thus extending the range

❑ AIS data is transmitted on VHF channels 87B and 88B

  o The bit rate is 9600bps, the modulation used is GMSK, and it uses TDM
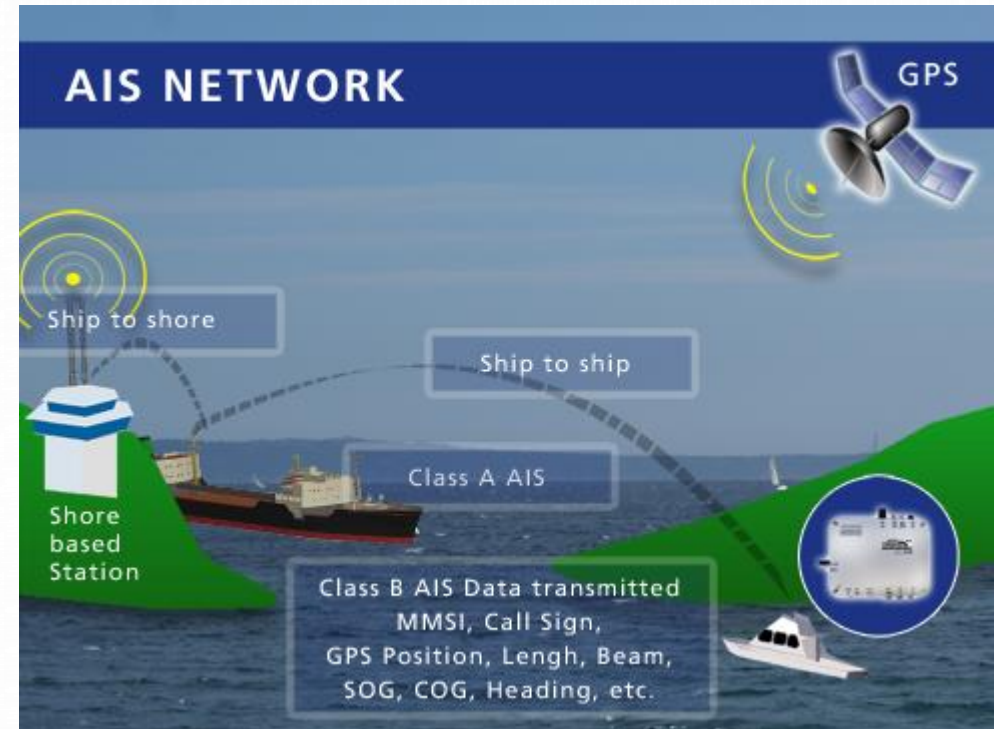
INMARSAT-C

- ❏ It is a data packet service operated by Inmarsat since 1991

- ❏ Works between MES (Mobile Earth Station) and LES (Land Earth Station)

- ❏ Does not allow voice communications

- ❏ It is the most used service for VMS (Vessel Monitoring System)

- ❏ The provided bit rate is 600bps

- ❏ Frequencies used: Tx 1626.5-1645.5MHz, Rx 1530-1545MHz

INMARSAT-C

❑ The service can provide:

- ○ E-mail

- ○ SMS

- ○ Remote monitoring

- ○ Tracking

- ○ Map and weather data update

- ○ MSI (Maritime Safety Information)

- ○ GMDSS (Global Maritime Distress and Safety System)

- ○ Emergency alert

COSPAS-SARSAT

COSPAS-SARSAT System Overview

COSPAS-SARSAT

❑ COSPAS-SARSAT is a satellite search and rescue initiative

❑ The purpose is to detect radio beacons activated by people, planes or ships in case of emergency and to transmit the information to the authorities

❑ The radio beacon has a frequency of 406MHz

❑ The beacon used by ships is called EPIRB (Emergency Position-Indicating Radio Beacon)

  o EPIRB can be activated manually or automatically upon contact with water

  o It is broadcasted periodically with a period of around 50s

    ▪ PLB – Personal Locator Beacon

   ▪ ELT – Emergency Locator Transmitter

COSPAS-SARSAT

❑ EPIRB contains information on:

- From which country it is issued

- An identification code "15-hex ID"

- Ship identifier (MMSI)

- GPS position

SSAS

❑ SSAS (Ship Security Alert System) is a special version of EPIRB used to warn the ship owner about a possible attack

- o Activates manually using a hidden button
- o Sends message to the ship's country of registration or to authorized SSAS operators using the COSPAS-SARSAT system
  - ▪ The message contains information about the ship (name, IMO ID, call sign, MMSI) and location (GNSS position, date and time)
- o The authorities within whose radius the vessel is located are notified
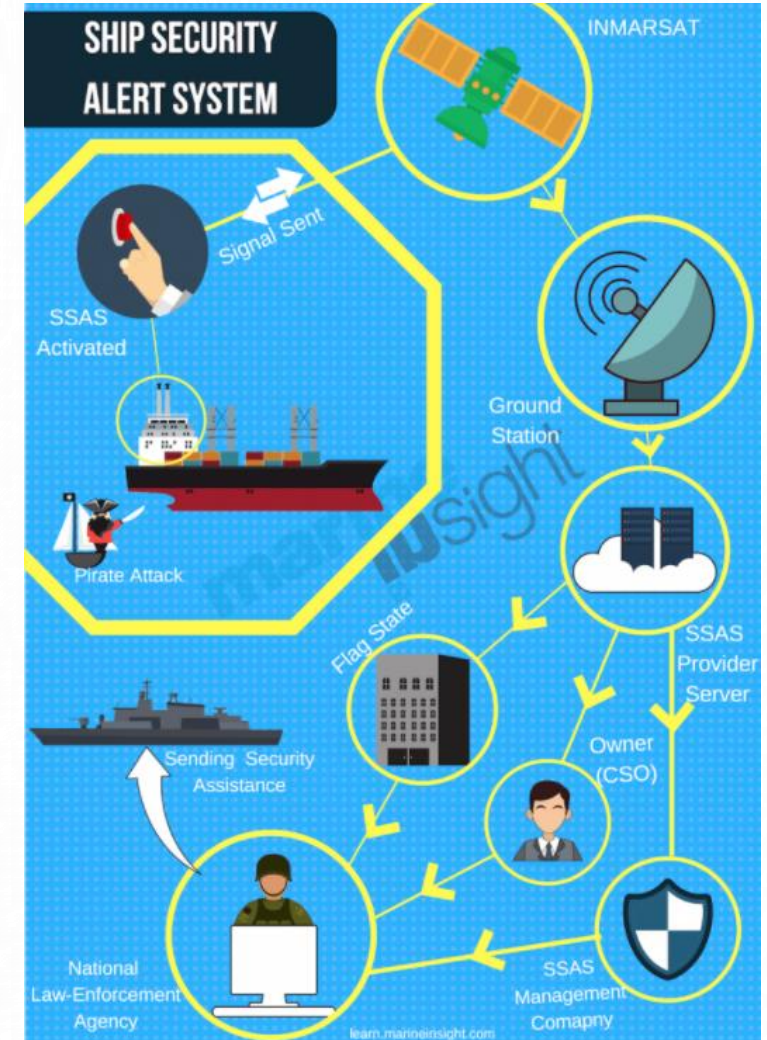
GMDSS

❑ GMDSS (Global Maritime Distress and Safety System) – is a set of internationally agreed procedures, types of equipment and communication protocols

❑ GMDSS includes several systems for the following functions:

- Alerts

- Search and rescue operations

- Location

- MSI (Maritime Safety Information) broadcast

- General communications

GMDSS

❑ GMDSS system components:

- EPIRB

- NAVTEX

- Satellites

  ▪ 2 certified suppliers: Inmarsat and Iridium

  ▪ Inmarsat F77 is used for telephone, telex and high-speed data services

- DSC

- Power source:

  ▪ Ship alternators/generators

  ▪ Emergency alternator/generator

 ▪ Dedicated battery for radio equipment

GMDSS

□ 4 GMDSS areas are defined that determine the available services and the necessary equipments:

- ○ A1 – Area with a VHF station on the shore with radiotelephony and DSC, 56-74 km from the shore
- ○ A2 – Area with an MF shore station different from area A1
- ○ A3 – An area within the Inmarsat radius, excluding A1 and A2
- ○ A4 – An area outside A1, A2 and A3
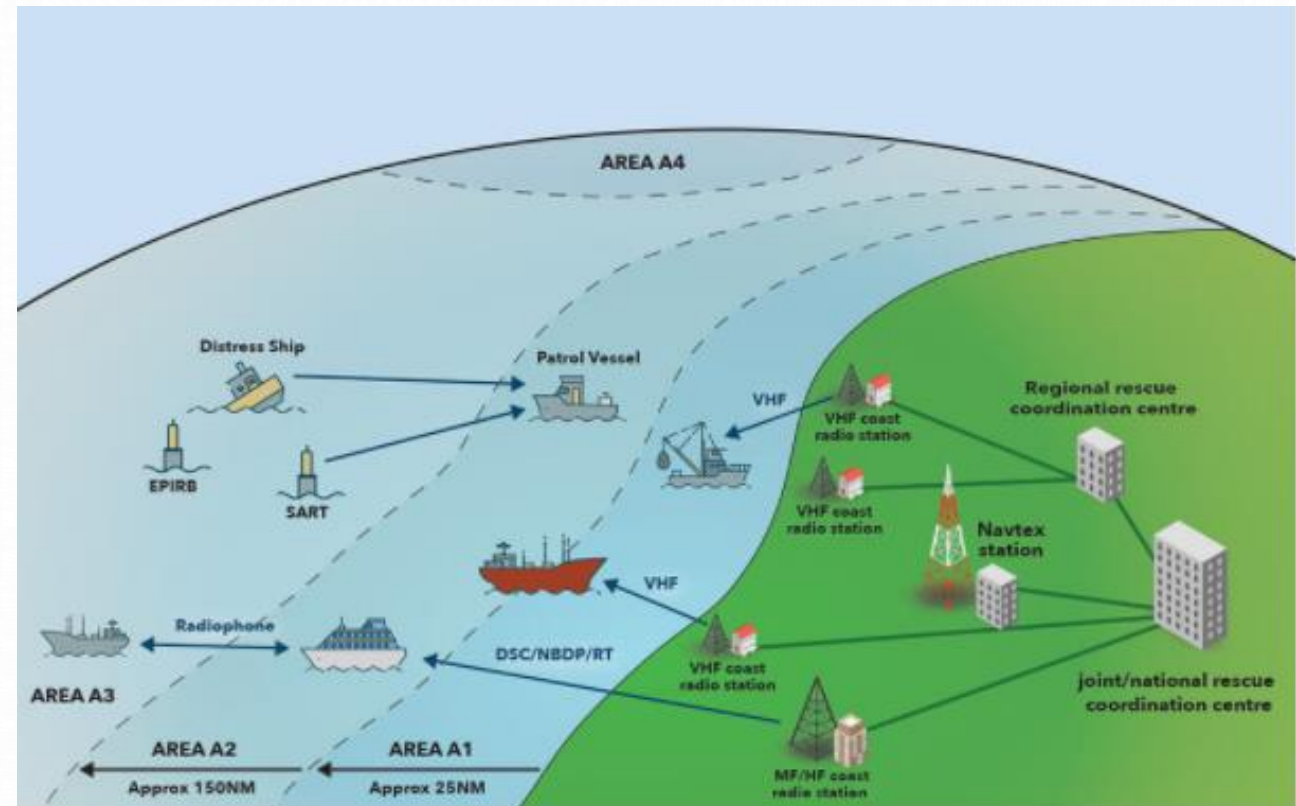
LRIT

❑ LRIT (Long Range Identification and Tracking) is a system used since 2006

❑ The purpose is to collect and distribute vessel position information

❑ It is a satellite-based system

❑ The LRIT system consists of:

    o LRIT equipment of the ship

    o CSP (Communication Service Provider)

    o ASP (Application Service Provider)

    o LRIT data centers

    o Data distribution plan

   o International Exchange Center

*IMO
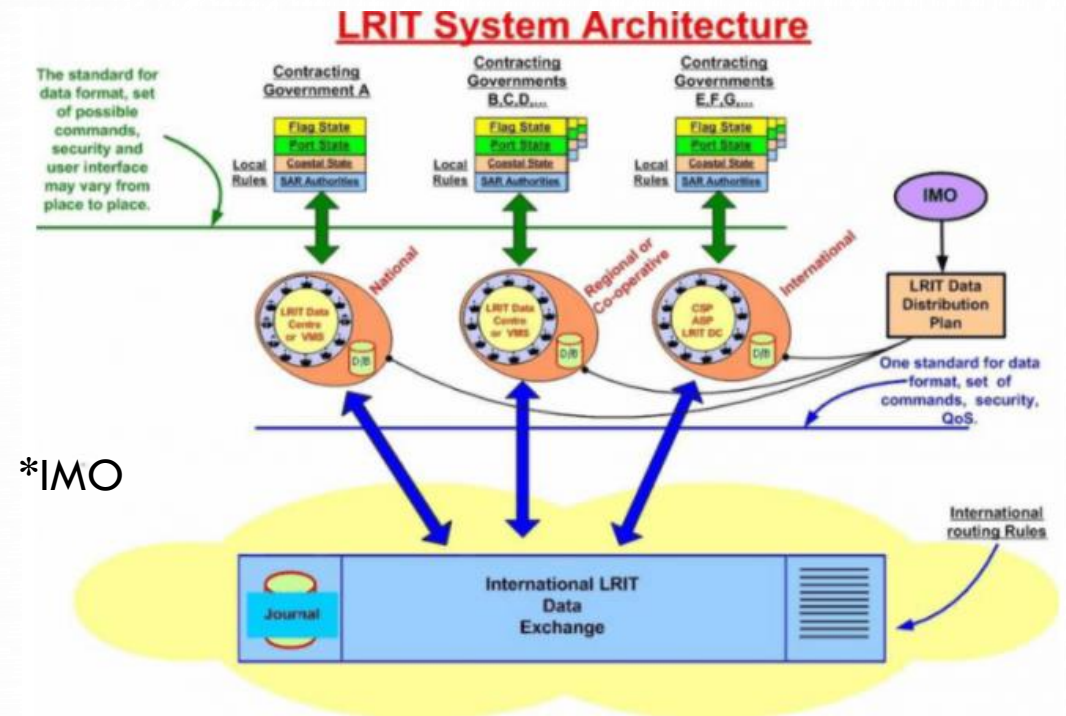
FREQUENCY ALLOCATION
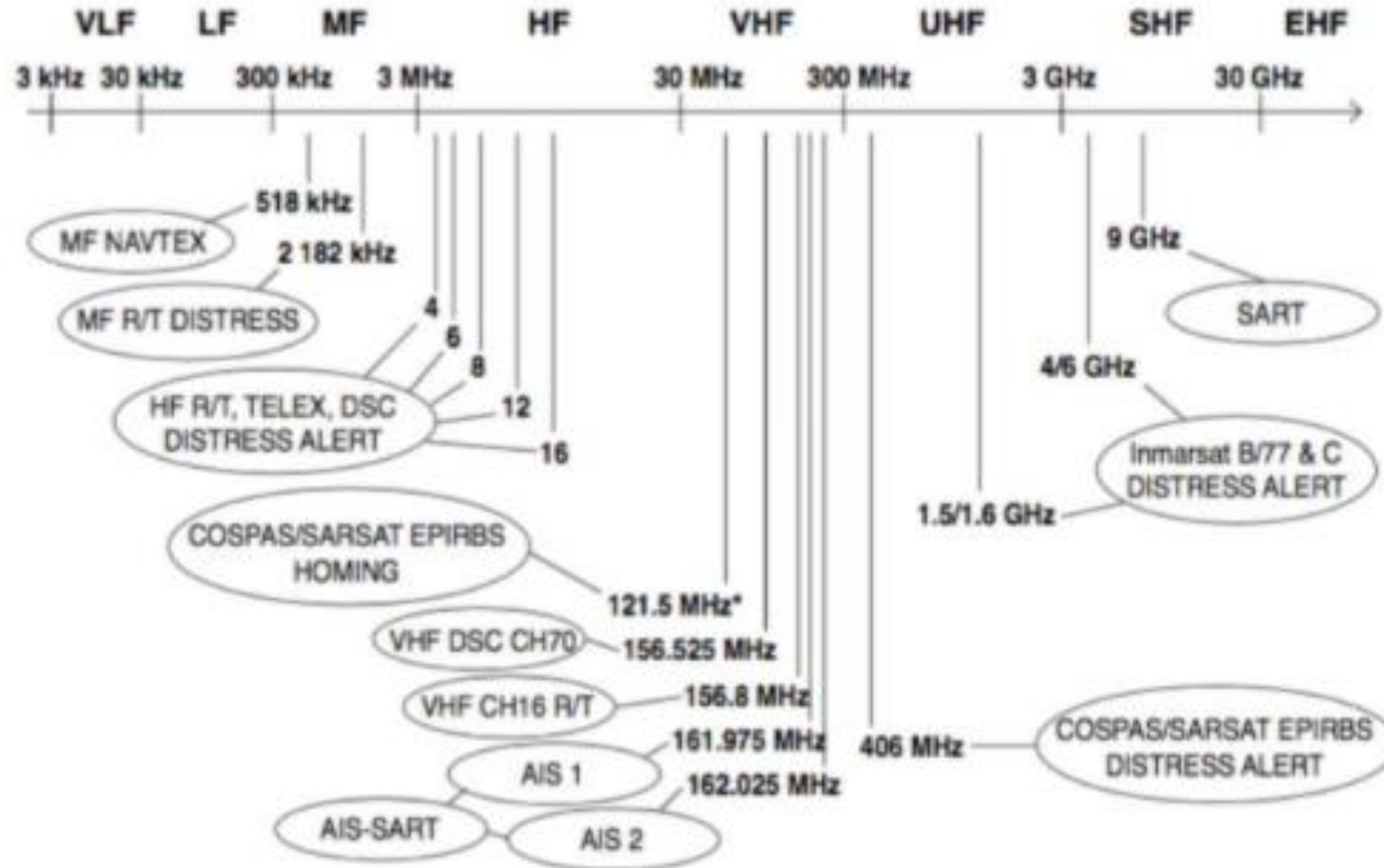
E-NAVIGATION

❑ It is a concept for the interconnection of ships and shore facilities

- IMO (International Maritime Organization): "the harmonized collection, integration, exchange, presentation and analysis of marine information on board and ashore by electronic means to enhance berth to berth navigation and related services for safety and security at sea and protection of the marine environment."

❑ The goal is to develop a system that can centralize all ship data
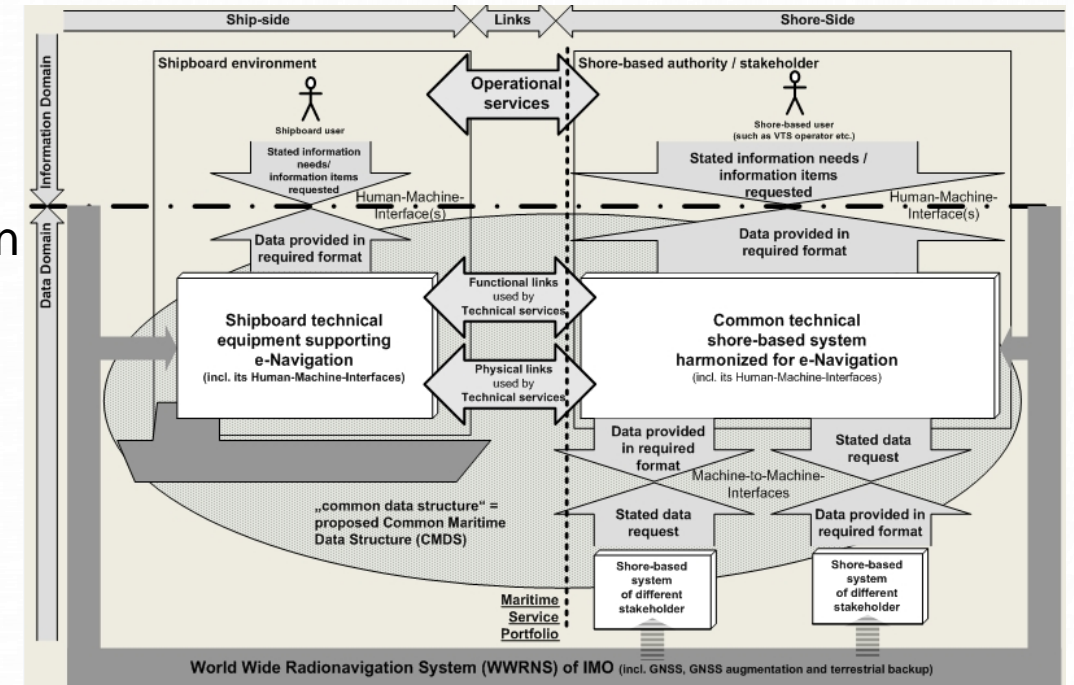
E-NAVIGATION

❑ Advantages of e-Navigation:

- Standardize equipment

- Reducing the number of local solutions

- Reducing the risk of accidents

- More efficient supervision, coordination, control

- Easier training

- More accurate information

- Better situational awareness

VDES

- ❑ VDES (VHF Data Exchange System)
  - ○ It is based on AIS
  - ○ It can provide bit rates up to 300kbps
- ❑ VDES implements the e-Navigation strategy
  - ○ ECDIS – Electronic Chart Display and Information System
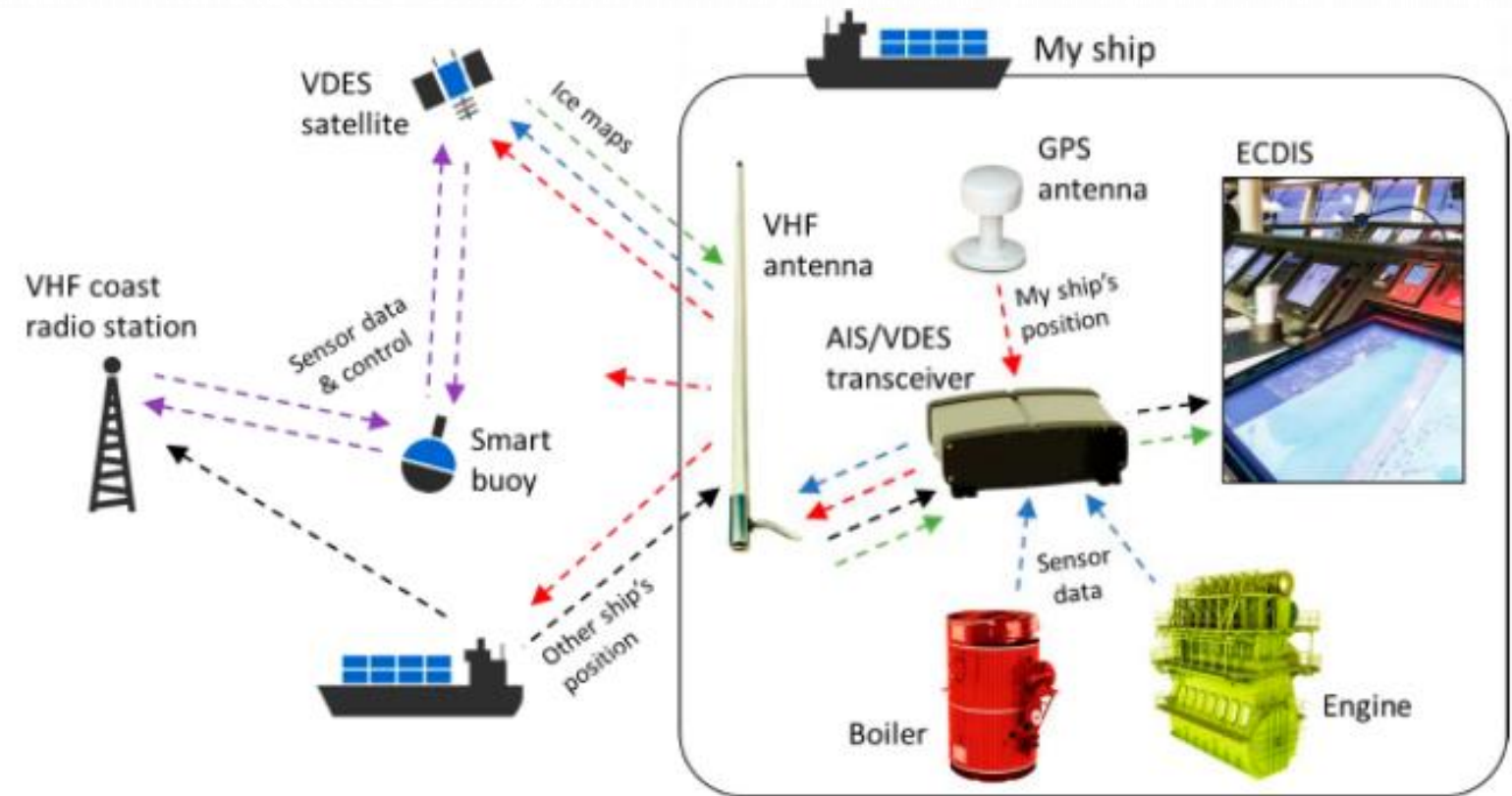
VDES

❏ VDES is divided into:

- ○ VDES-TER: ship-to-ship, ship-to-shore communications
- ○ VDES-SAT: ship-to-satellite communications

❏ Uses bidirectional VHF data channels

❏ VDES uses adaptive coding schemes and modulations

❏ VDES under development

❏ Complete VDES deployment is expected to be finished in 2030 until when adminstrations have to completely vacate the VDES VHF channels from voice communications