COMMUNICATIONS FOR MARITIME SAFETY AND EFFICIENCY

Francis Zachariae, Secretary-General, IALA

IALA and its Purpose

- Non profit, international technical association established in 1957

- Two Goals aimed at a harmonised and complete global aids to navigation system by 2026

- Standards, Recommendations, Guidelines, Manuals, Model Courses

Technical Committees

The "Power House" of IALA

- AtoN Requirements and Management (ARM)
- Engineering and Sustainability (ENG)
- Vessel Traffic Services (VTS)
- e-Navigation (ENAV)

Maritime industry drivers for future radio spectrum use

- IALA focuses on the safety and efficiency of navigation
  - Not concerned with spectrum for ship social & media needs, ship systems management, etc.

- Drivers are:
- Maritime safety information, and weather and ice information
  - Using various channels, 500KHz up to satellite
- Ship-ship and ship-shore interaction is most important in the coastal phase of a voyage
  - Vessel Traffic Services (VHF voice today)
  - Shore authority monitoring
  - Ship reporting for safety, for legal/customs/immigration/ port operations
  - Vessel tracking for safety and security
- Aids to Navigation
  - Racons X and S bands, AIS Aids to Navigation in VHF band
- Positioning services, space and terrestrial

New trends affecting spectrum and bandwidth needs

- Increased digital interaction in coastal and harbour phases of a voyage
  - Single window reporting requirements
  - Expected transition of VTS to digital data
  - Near real time flow of hydrographic and AtoN information
    - Continually updating ships' charts and navigation data
- Piracy and illegal or suspicious maritime activity
  - Driving digital surveillance in oceanic and coastal phases
  - Presently AIS reception, in future by dedicated VDES channels
- Projects to increase the efficiency and sustainability of the maritime transport chain
  - Just in time
  - Collaborative decision-making within port services
  - Coordination of sea transport with land and river transport connections
- Autonomous ships
  - Communications needs for navigation and pilotage are presently unclear

Connectivity possibilities for navigation services are extensive

- VDES (includes AIS, ASM, VDE-T and VDE-S)
- DSC (VHF, HF, MF)
- NAVDAT (development of NAVTEX)
- Wifi
- 3G/4G (including WiMAX & LTE; LTE-A; LTE-M)
- 5G
- Satellite (GEO; MEO; LEO)
- Digital HF
- Maritime Broadband Radio developments

IALA's radio communication plan for maritime

- Covers all spectrum requirements for maritime radio communications

- Reflect outcomes of WRC-15 and preparation for WRC-19

- Also takes into account the maritime communications requirements of other users, including domestic commercial vessels and recreational craft.

VHF Data Communications

- AIS was implemented worldwide for SOLAS ships
  - For ship-ship and ship-shore information exchange
  - For safety of navigation
- But channels AIS1 and AIS2 are increasingly occupied
  - Fishing net markers, transmitters used by divers, others
  - Disrupting navigation displays on-board
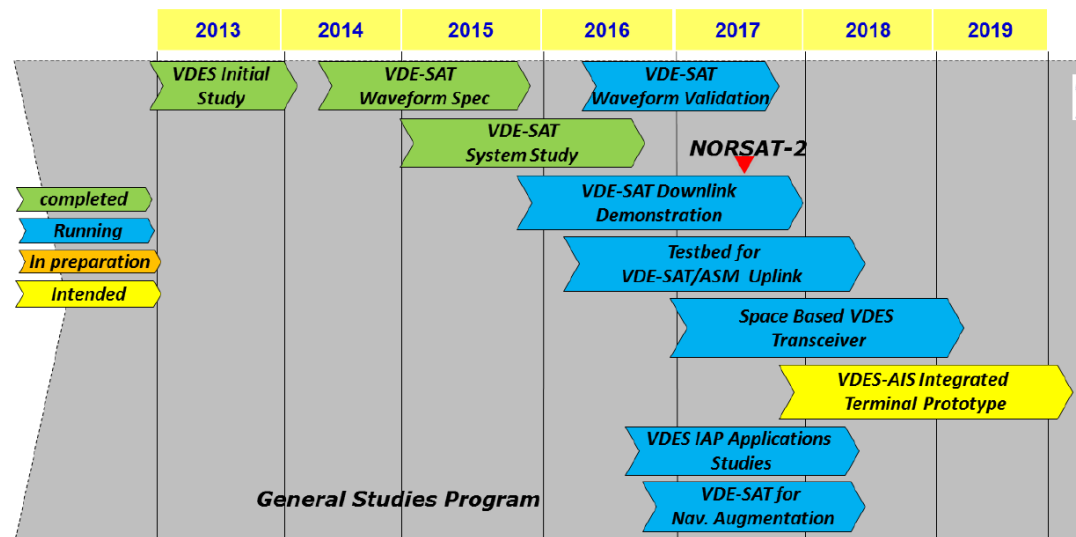 - Some authorities are having difficulty regulating these devices

VHF Data Exchange System, VDES

- Relieve VDL loading
  - Keep AIS1 and AIS2 for safety of navigation

- Move ASMs to separate channels
- Satellite channels for vessel detection and tracking (LRIT)
- Satellite up and down links for remote areas (Polar regions, oceans)
- Medium speed data channel (100KHz) for data exchange

2013	2014	2015	2016	2017	2018	2019

VDES Initial Study

VDE-SAT Waveform Spec

VDE-SAT Waveform Validation

VDE-SAT System Study

NORSAT-2

completed
Running
In preparation
Intended

VDE-SAT Downlink Demonstration

Testbed for VDE-SAT/ASM Uplink

Space Based VDES Transceiver

VDES-AIS Integrated Terminal Prototype

VDES IAP Applications Studies

VDE-SAT for Nav. Augmentation
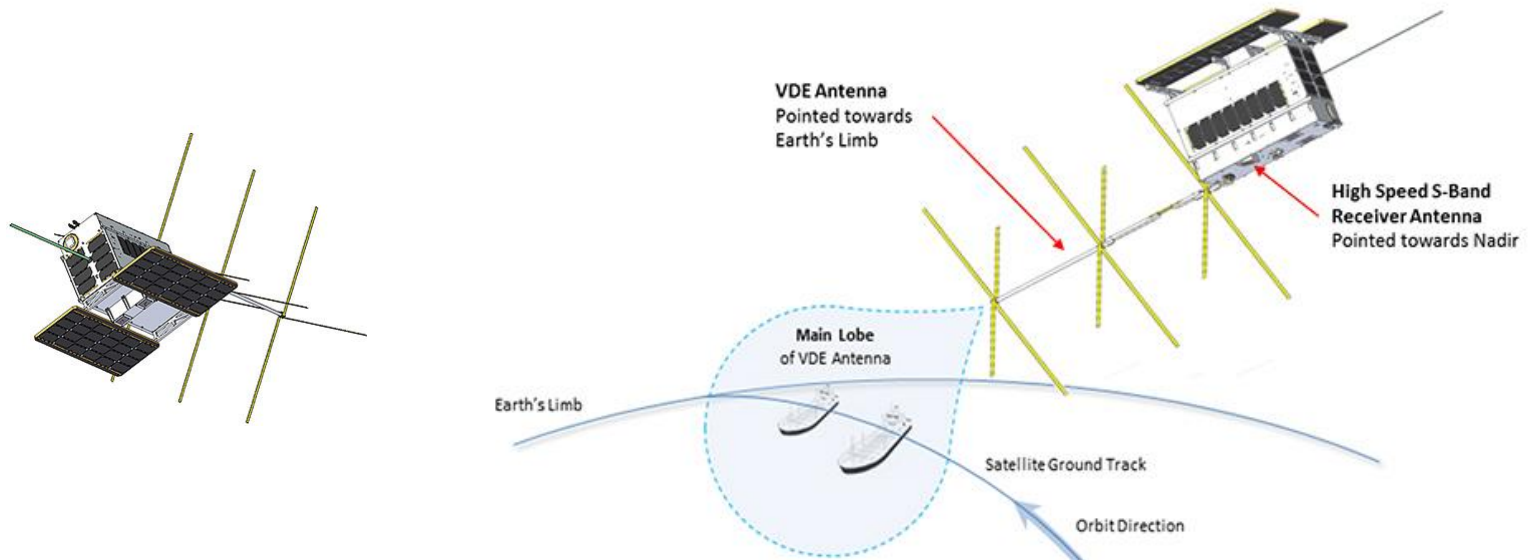
General Studies Program

VDES merits

- Technical standards near complete – ITU-R.M2092 and IALA Guideline
  - Frequencies allocated by ITU (awaiting satellite channels, WRC2019)

- Shore side
  - Easy conversion of existing AIS Base Station sites
  - Good coastal and harbour coverage

- Ship side
  - Requires update or replacement of AIS hardware
  - But cabling and antennas OK
  - No cost for messages
  - Trusted data over "closed" VHF system

ITU-R
Radiocommunication Sector of ITU

Recommendation ITU-R M.2092-0
(10/2015)

Technical characteristics for a VHF data exchange system in the VHF maritime mobile band

VDES is already happening

- EU Efficiensea project
- Sesame (Malacca and Singapore) Straits
  - Route exchange between ship and shore using the VDE channels
- ESA projects
- STM Validation project – using VDE channels
- Kongsberg, CML, and others have equipment in manufacture
- Norsat 2 Satellite – tests of broadcast from LEO satellite now in orbit

VDE Antenna Pointed towards Earth's Limb

High Speed S-Band Receiver Antenna Pointed towards Nadir

Main Lobe of VDE Antenna

Earth's Limb

Satellite Ground Track

Orbit Direction

Non SOLAS

- Korea is planning to use LTE/5G within its Smart Navigation project
  - For Fishing and leisure vessels
  - Where most accidents happen
- Japan and others have implemented smart-phone systems in local areas for small craft

Maritime Connectivity Platform

- Services can be easily registered, discovered, and used
- Identities can be verified
- Digitally signed data exchange
- Location used as a parameter for service discovery, identity verification and message transfer
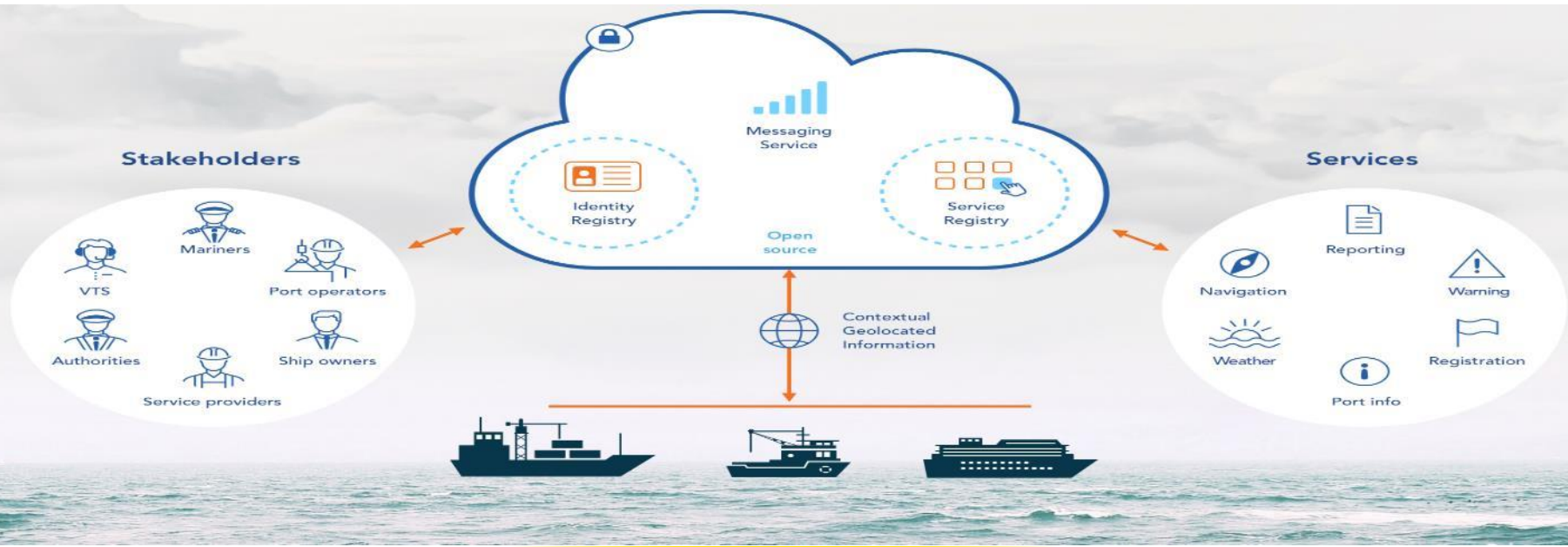
Everyone uses satellite navigation

- Will become better in accuracy, availability, and resilience
  - GPS, GLONASS, Galileo, BeiDou
  - Supplemented by SBAS
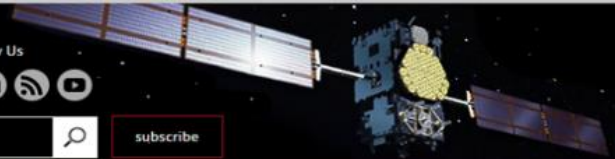
- But all GNSS are susceptible to space weather and intentional disruption

IALA view on terrestrial backup for GNSS

- eLoran would be great
  - But there is limited national support
  - Probably no chance of extensive global implementation

- We can use existing assets to provide terrestrial PNT back-up in coastal and harbour areas
  - Where the RPNT need is greatest
  - DGPS stations
  - AIS/VDES base station networks

- Concept is called "R-Mode"
  - Accuracy tens of metres at MF, maybe a few metres at VHF

R-Mode status

- Concept developed within the EU ACCSEAS project
- "Baltic R-Mode Project" just started
  - With government & commercial partners and EU funds
- VHF R-Mode trials have already been conducted in China
  - Promising accuracies obtained
- Aim – an IALA-harmonised system for coastal and harbour areas globally

Autonomous Ships Will Be Great

Doing away with sailors will make the high seas safer and cleaner.

By **Adam Minter**

34 16 May 2017 23:00

Space technology to drive autonomous ships
December 1, 2017

ESA will improve satellite-based ship identification and tracking in partnership with the European Maritime Safety Agency and exactEarth to meet the requirements of users, particularly those of government agencies such as coastal administrations. Credit: European Space Agency

ESA Director General Jan Wörner signed a Memorandum of Intent with Rolls-Royce today, as the two entities agree to investigate how space technology can be used to develop autonomous and remote-controlled ships.
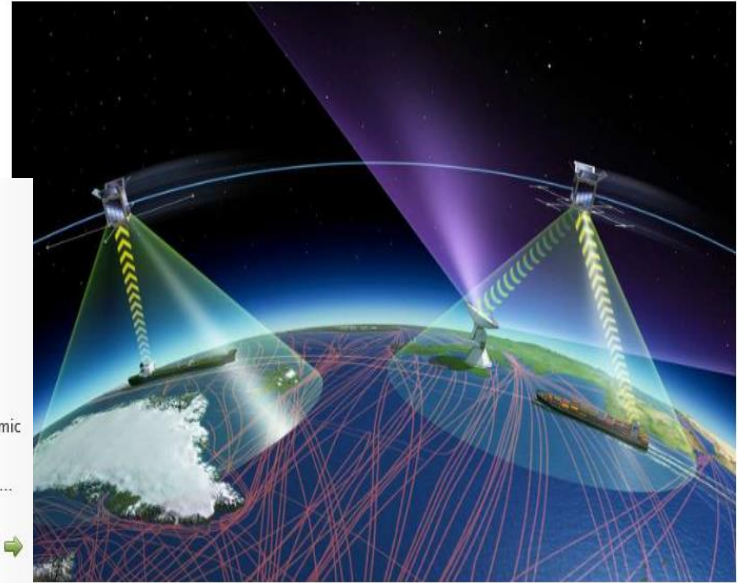
London Times – "We'd Be Lost Without GPS Says Royal Institute of Navigation"
December 5, 2017

Blog Editor's Note: The British government has been actively addressing this issue. See the economic impact analysis they did earlier this year. We understand additional work...
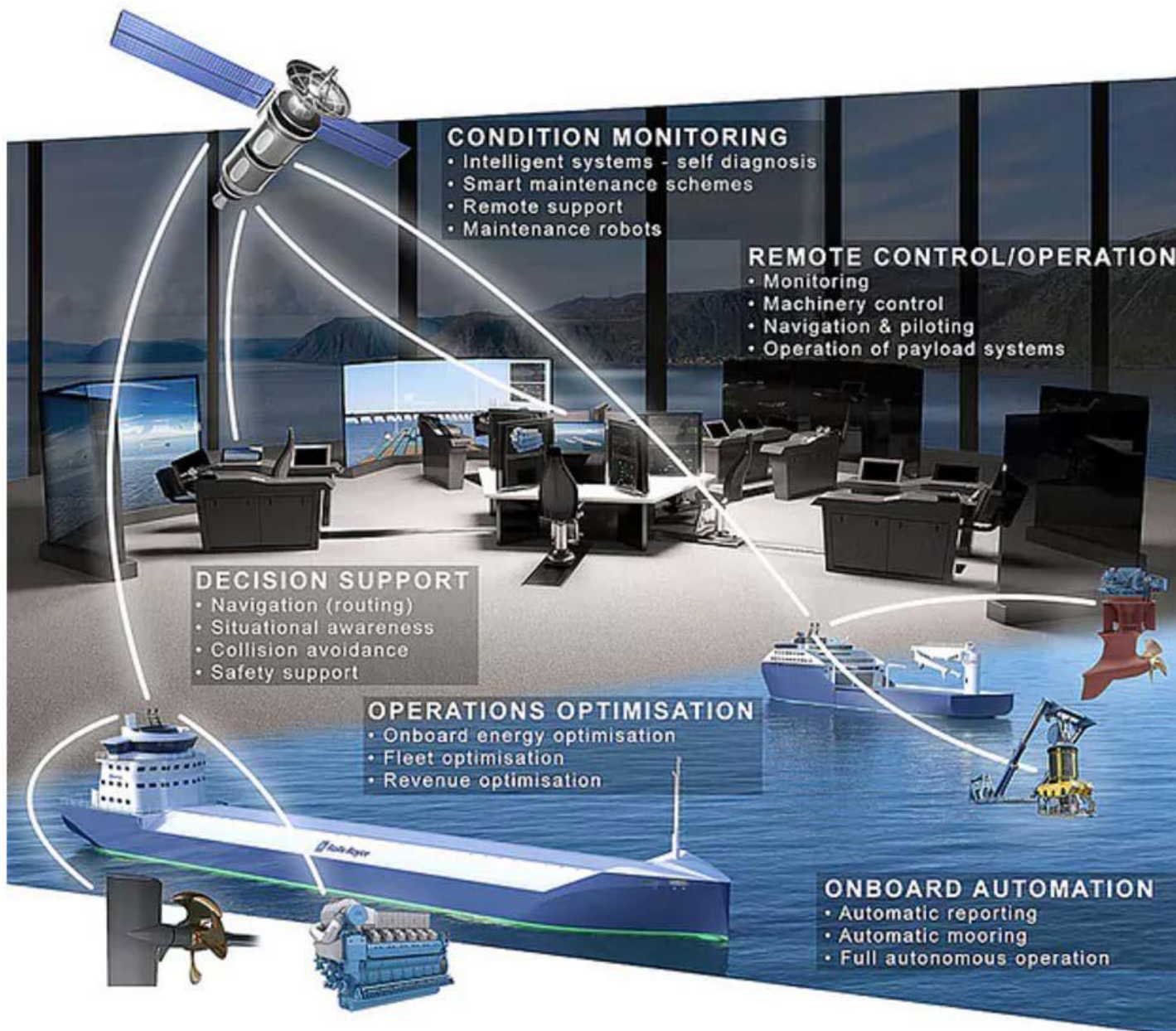
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About Sea Traffic Management

STM - THE NEXT STEP FOR A SAFER, MORE EFFICIENT AND ENVIRONMENTALLY FRIENDLY MARITIME SECTOR

Route plan exchange format - RTZ

Route plan exchange is used in conjunction with ECDIS to IEC 61174.

THE PORT CDM CONCEPT – A FINALIST FOR INNOVATION AWARD

CONDITION MONITORING
- Intelligent systems - self diagnosis
- Smart maintenance schemes
- Remote support
- Maintenance robots

REMOTE CONTROL/OPERATION
- Monitoring
- Machinery control
- Navigation & piloting
- Operation of payload systems

DECISION SUPPORT
- Navigation (routing)
- Situational awareness
- Collision avoidance
- Safety support

OPERATIONS OPTIMISATION
- Onboard energy optimisation
- Fleet optimisation
- Revenue optimisation

ONBOARD AUTOMATION
- Automatic reporting
- Automatic mooring
- Full autonomous operation

The future for maritime communications for navigation

- Shore services from Competent Authorities
- Connectivity, ship-ship-, ship-shore, shore-shore
    - Harmonised digital connectivity
    - Coordinated digital services, global and regional
    - Harmonised messages allowing all stake-holders to create own services
    - Future digital Vessel Traffic Services
- Resilient Position, Navigation and Timing (RPNT)

THANK YOU

Francis Zachariae