

The 6th International Maritime Transport and logistics Conference

GLOBAL INTEGRATION IN PORTS

FUTURE OPPORTUNITIES



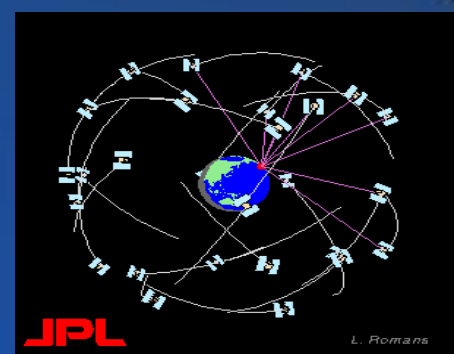
19-21 March 2017 Alexandria - Egypt



APPLICATIONS OF THE VIRTUAL AND ENHANCED AIDS TO NAVIGATION IN INTEGRATED PORTS

Refaat Rashad
Arab Institute of Navigation

Refaat Rashad

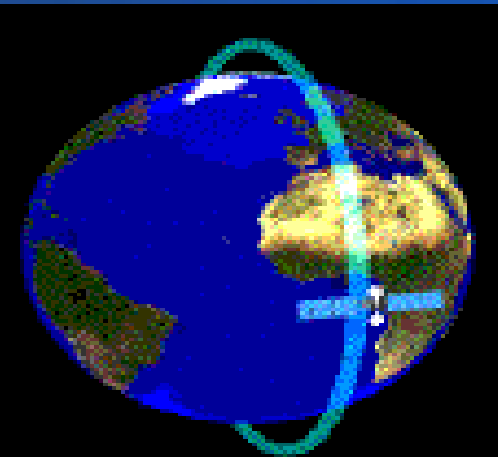


Currently

President of the Arab Institute of Navigation
Member of NASA GPS Advisory Board, USA

Previously

PhD in Navigation Technology
IMO Marine Expert
Head of The Department of Post
Graduate, Maritime Technology, AAST&MT

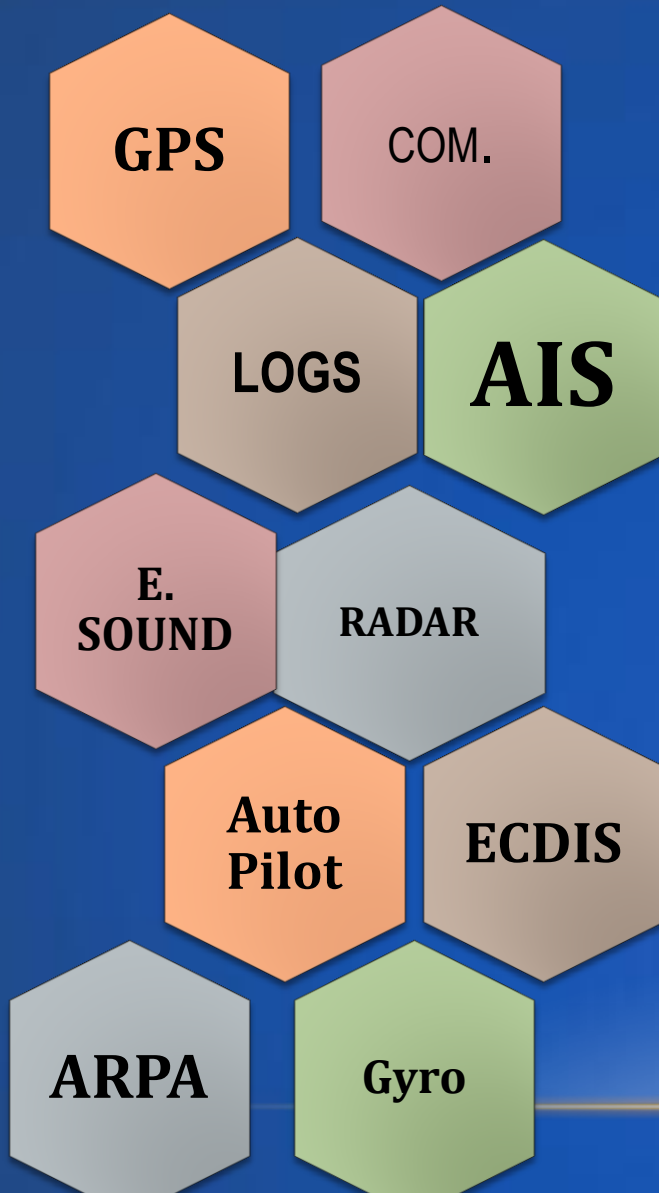


NAVIGATION

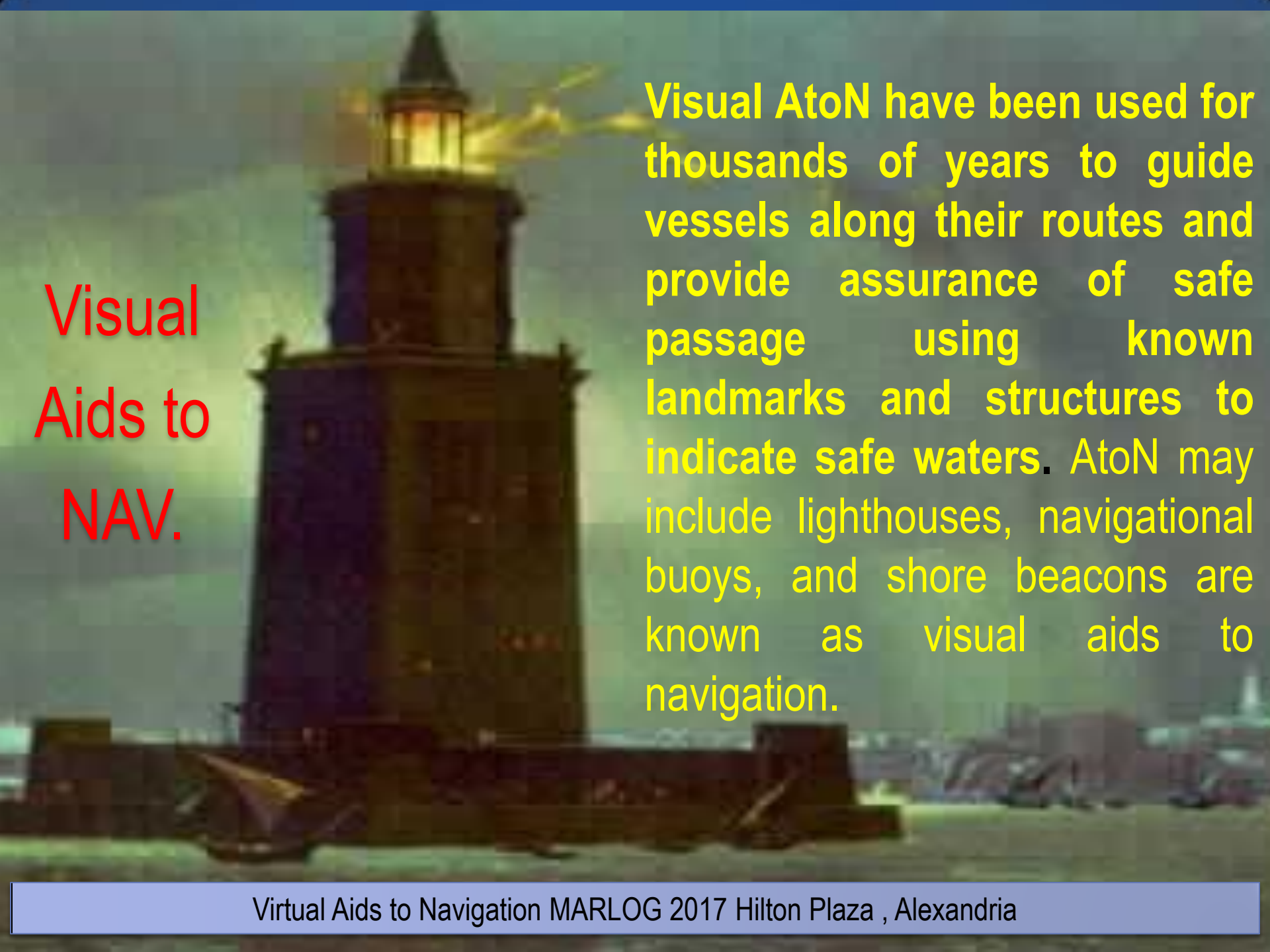


- Navigation is the art and science of knowing the position, time, direction, speed and the distance made by the moving object.
- The safety of navigation depends on the use of proper navigation equipment and the on-board ship's systems.
- However it should be also supported by adequate shore and radio aids to navigation.

NAVIGATION SYSTEMS



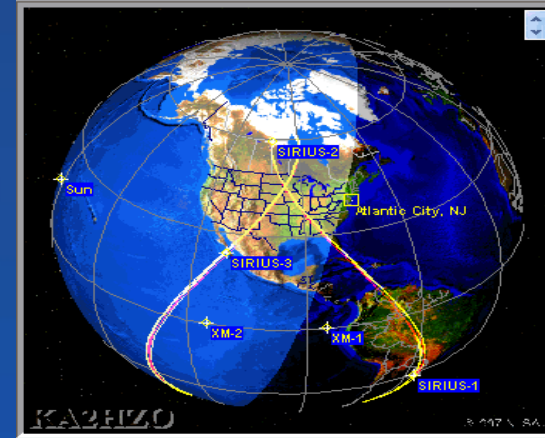
- NAVIGATION SYSTEMS refers to the onboard systems and equipment which help the mariners to perform safe navigation, such as radars, charts, Automatic Identification System AIS, compasses, communication systems and the Global Navigation Satellite Systems GNSS, speed logs, depth measurements and a number of tables and publication which are made available to mariners to facilitate their safe navigation.



Visual Aids to NAV.


Visual AtoN have been used for thousands of years to guide vessels along their routes and provide assurance of safe passage using known landmarks and structures to indicate safe waters. AtoN may include lighthouses, navigational buoys, and shore beacons are known as visual aids to navigation.

E-NAVIGATION



- E-navigation is a broad vision led by IMO for the harmonization of marine navigation systems and supporting shore services.
- E-Navigation aims at facilitating safe and secure navigation of vessels and communications, including data exchange between vessels and shore, integrate and present information onboard and ashore that maximizes navigation safety benefits and minimizes any risk of confusion.

THE ROLE OF IALA

- 
- IALA was formed in 1957 as a technical association to provide frame work for aids to navigation from all state members to;
 - 1 standards for aids to navigation systems worldwide.
 - 2 Facilitate the safe and efficient navigation
 - 3 Enhance the protection of marine environment.

IALA, related organizations are;

- (IMO), (PIANC), (IHO), (ITU).
- IALA, provides advice or assistance and guidelines.

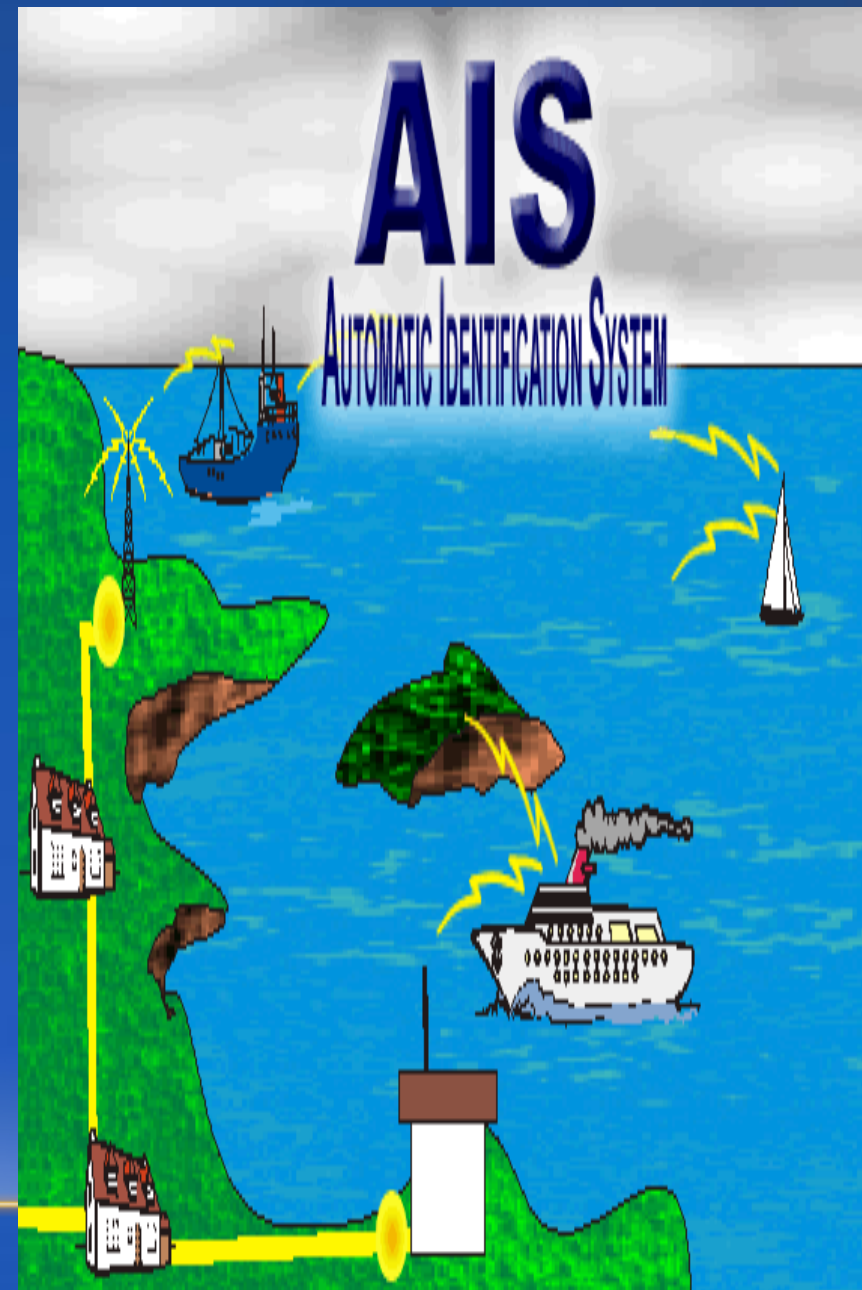
DEFINITION OF AN AID TO NAVIGATION

Any device, external to a vessel,
intended to assist navigators to
determine their position, safe
course, or to warn them of dangers
or obstructions
To navigation.

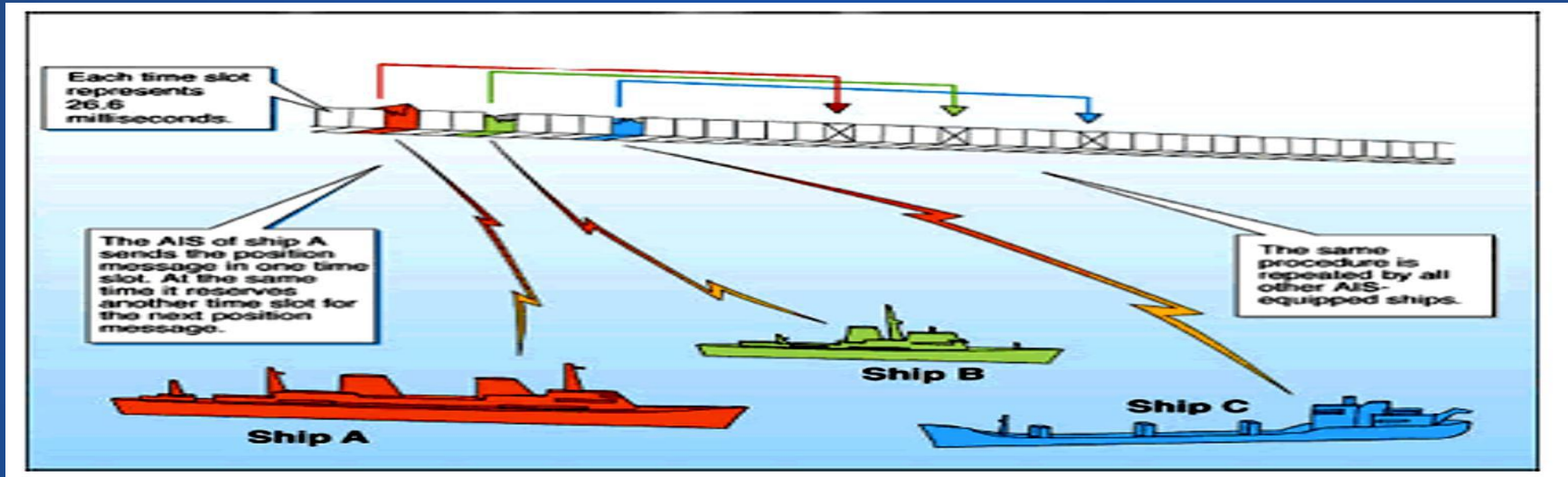


AUTOMATIC IDENTIFICATION SYSTEM AIS

- **AIS** is communication protocol that enables a continuous exchange of information used for identifying and locating other vessels, base stations, and aids to navigation..
- **VHF transponders** located on Vessels or other locations that transmit and receive information on dedicated VHF frequencies.



AIS REPORTING CAPACITY



- AIS provide 4500 time slots per minute.
- Two VHF dedicated for AIS transmission
- The transmission system is known as (TDMA) regulated by the (GPS)

The system capacity is about 400 ships within a radius of VHF coverage in a ship to ship mode.

DISPLAY OF AIS DATA

- AIS information can be displayed on AIS screen, Radar screen, and ECDIS screen

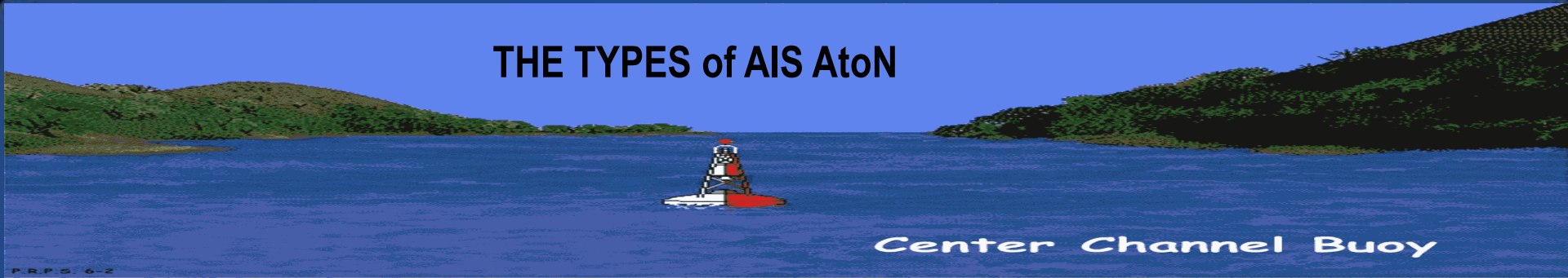


INFORMATION TRANSMITTED BY AIS ATON



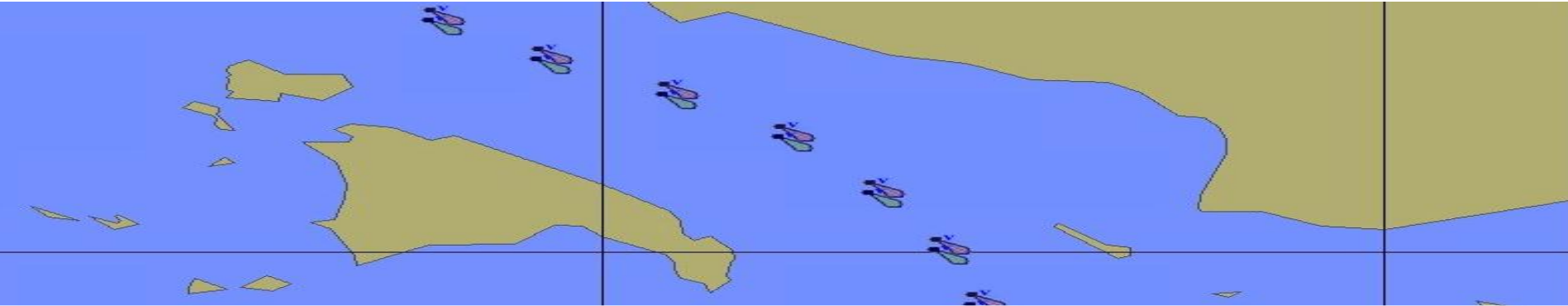
- The AIS Aids to Navigation **Report message** provide information about the AtoN in uses e.g.
- **Type, name, position** of the AtoN, and the off-position indicator.
- **reporting interval is 3 minutes** and can be received within the VHF coverage range.

THE TYPES of AIS AtoN



- ***1- Real AIS Buoy :**
- The AIS signal is transmitted from a physical aid with AIS.
- ***2- Monitored and Predicted Synthetic AIS Buoy :**
- The monitored synthetic **AtoN** refers to a physical Buoy that transmits its position to a shore station. The shore station, in turn, broadcasts an AIS signal as if it is coming from the buoy .
 - **Predicted Synthetic AIS Buoy** is transmitted from an AIS station located remotely from the Buoy.
The Buoy physically exists but not monitored to confirm its location .
- ***3- Virtual AIS Buoy :**
- The physical aid does not exist and is broadcast via AIS from another remote AIS station location, physical Buoy does not exist

VIRTUAL AIS BUOYS NO PHYSICAL BUOYS EXIST



- **The Good**
- **The Bad**
- **The Ugly**
- **OF Virtual**
- **AtoN**



THE GOOD I



- By far, the main benefit that governmental authorities put forward is the **significantly lower cost** of maintaining and repairing a virtual ATON as compared to a physical ATON.

Virtual aids can be used to **mark shallows or obstructions**, Vessel Traffic Separation Schemes, harbor approaches and restricted waterways channels, and even lighthouses.

•

THE GOOD II



- Virtual AtoN offer improvements response time to wrecks and other dangers, mark a wreck or new danger in areas where it is impossible to replace missing physical buoys.
- **Can be used in** situations when it is not possible to equip or due to limitation of time
- Virtual AtoN can be completed within a very short duration of time thereby aiding mariners to avoid unexpected hazards and dangers to navigation .

THE GOOD III



- They have the ability to move the marked locations as conditions change
- -Used to mark anchorages, restricted or dangerous areas as well as in environmentally sensitive and isolated coastline.
- Virtual aids to navigation can provide good coverage.
- Ships can identify underwater hazards well ahead .
- Virtual AtoN can be detected around bends and behind islands and offer a more accurate positioning.

THE BAD OF VIRTUAL ATON I



- Positional data within the transmissions may be **inaccurate**.
- **Untrained officers** may overlook such information as they are not visible in reality.
- **Not all vessels** are fitted with AIS.
- AIS are dependent on **GPS position and timing**
- Unusual **atmospheric conditions** could effect the range.

THE BAD II

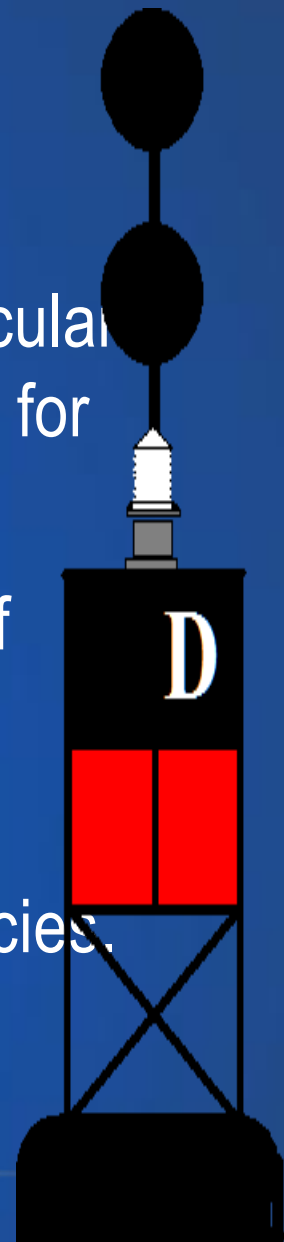


- Virtual aids to navigation systems can be **vulnerable to intentional** and unintentional interference .
- In the absence of ECDIS or radar overlay, users will not be able to fully use the **AIS ATON functionality**.
- If a vessel's AIS unit is malfunctioning or incorrectly installed, may **receive incorrect data**.

THE UGLY I

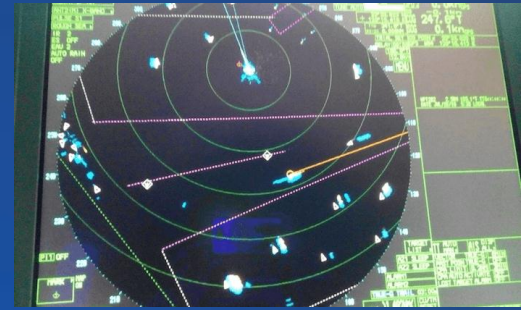
AIS SPOOFING AND JAMMING

- **The ability to spoof and jam** AIS broadcasts has particular significance risk on AIS where AtoN signals are used for vessel navigation.
- **A lack of security controls** can cause ship diverted off course by placing AtoN in undesirable or dangerous locations for hijacking and piracy purposes.
- **There can be GPS errors** causing positional inaccuracies.



THE UGLY II

GPS SPOOFING, JAMMING AND OUTAGE,



- GPS signals can be spoofed and jammed causing unreliable and even deceptive navigation signals to be received by vessels and AIS AtoN.
- Personal privacy jammers can severely interfere the GPS signals.
- All GNSS regardless of technology used are subject to the same atmospheric and signal propagation limitations, multipath interference, orbit errors, satellite geometry.

CONCLUSIONS I

- **The Virtual Aids to Navigation** has been one of the greatest achievements in recent navigation .

It can be used in situations where it is not practical to use physical aids to navigation, or where information is needed faster than a buoy can be placed.

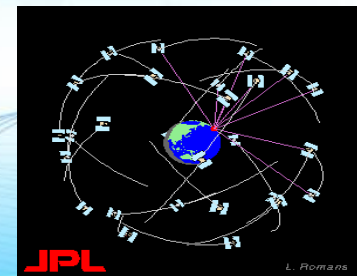
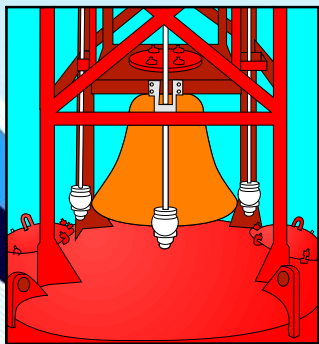
IALA encourages authorities to consider the use of Virtual AtoN in accordance with its recommendation and guideline.

Risk analysis should be performed before decision is taken to implement virtual AtoN to determine which navigation routes are high risk or particularly hazardous.



CONCLUSIONS CON. II

- **The possibility to mix** traditional physical AtoN technology with virtual AtoN may prove to be a feasible option.
- **Significant potential** vulnerabilities exist in the AIS and GNSS technologies. Spoofing and denial of service attacks is possible.
- **Virtual Aids to Navigation** are not meant to replace physical aids to navigation, however they address the need to make hazards at sea visible when costly physical buoys are difficult to deploy.
-
- **The IMO's e-Navigation** conception recommend some form of cost-benefit analysis during the initial phases.



Thank You!