METIS Second Training & Seminar Day
Cairo, 6 – 7 November 2007

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About the Author

- Dr. Captain Refaat Rashad
- B.Sc. 1976 University of Wales UK
- M.Sc. 1977 University of Wales UK
- Ph.D. 1983 University of Wales UK
- Master Mariner 1969 Alex Egypt
- Professor of Navigation, Arab Academy for Science, Technology & Maritime Transport.
- President of Arab Institute of Navigation (AIN)
- IMO Marine Expert
GNSS MARITIME APPLICATIONS

- INTRODUCTION
- MARITIME USERS
- GNSS AVAILABILITY
- USERS REQUIREMENTS
- MEDA COUNTRIES CURRENT STATUS AND ROAD MAP

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INTERNATIONAL MARITIME ORGANIZATION

- THE OBJECTIVE OF IMO IS TO ASSURE,
  - Safety of Lives
  - Safety of Cargo, Commodities and Trade
  - Safety of Ports and Maritime Infrastructure
  - Safety of Marine Life
  - Protection of Marine Environment and
  - Assurance of Clean Seas

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INTERNATIONAL MARITIME ORGANIZATION

- IMO objectives are achieved through, International Agreements, Conventions, Regulations, Rules, Recommendations, and Memorandum of Understandings.
- All MEDA countries are members of IMO and adopted basic conventions for Safety, Security, and Environmental Protection.
**Navigation Requirement Performance**

**SOLAS Ships**, all ships involved in commercial operation and passenger ships irrespective to the size. Solas ships should be fitted with Global Navigation Satellite System or terrestrial system, update ship position by automatic means. 1998 resolution, was adopted for civil GNSS Internationally Operated.

**NON SOLAS SHIPS**
War ships -- Government vessels
Ships below 150 Grt. fishing vessel,
Ships less than 500 Grt not engage in international voyage.

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**European GNSS Supervisory Authority**

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### INTERNATIONAL FLEET

<table>
<thead>
<tr>
<th>Type</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil tankers</td>
<td>336,156</td>
<td>37.5%</td>
</tr>
<tr>
<td>Bulk carriers</td>
<td>320,584</td>
<td>36.0%</td>
</tr>
<tr>
<td>General cargo</td>
<td>92,048</td>
<td>10.0%</td>
</tr>
<tr>
<td>Container ships</td>
<td>98,064</td>
<td>11.0%</td>
</tr>
<tr>
<td>Ferries + passengers ships</td>
<td>5,589</td>
<td>0.1%</td>
</tr>
<tr>
<td>Others</td>
<td>43,402</td>
<td>0.4%</td>
</tr>
<tr>
<td><strong>Total of world fleet at 2005</strong></td>
<td><strong>895,843</strong></td>
<td><strong>37.5%</strong></td>
</tr>
<tr>
<td>About 1800 vessel is added every year</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
IALA, is the International Association of Maritime Aids to Navigation and Lighthouses Authorities. It is responsible for setting standards for Maritime Radio Navigation Services, Alger, Egypt, Tunisia, Israel and Morocco are member of IALA.

IHO, International Hydrographic office. It is responsible for the Nautical Charts and safe sea routes.
MARITIME USERS

PASSENGER AND CARGO SHIPS

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Tankers
Tonnage up to 500,000 Grt of crud oil.

363000 tankers Navigating around the Glob
BULK CARRIERS
FISHING VESSELS

- Thousands of fishing vessels use GNSS for locating their catches
Leisure Crafts
The Evolving GNSS Panorama
GNSS Milestones

- 1967 Transit Satellite
- 1978 First GPS Satellite Launched
- 1982 First GLONASS Satellite Launched
- 1996 IMO Recognized GPS & GLONASS
- 2000 Galileo official go ahead
- 2002 GNSS 1 (GPS+ GLONASS+ EGNOS + WAAS )
- 2004 EGNOS operational
- 2005 GPS L5 civil Frequency
- 2005 First Galileo Satellite launched- GIOVA
- 2006 Galileo Frequency (SIS)
- 2007 GPS / Galileo interoperability in progress
- 2012 GNSS2 (GPS + Galileo +GLONASS + EGNOS)
Navigation Satellite Systems

American GPS

• 24 Satellites Cons. (29)
• 55 degree inclination
• 20200 km height
• 6 Orbits
• period of 11hr & 56min.
• 8~9 Sat. are visible
• Two Services
  • P code & C/A code
  • Military System

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Russian Satellite System

GLONASS

- 24 satellites (13)
- Height 19100 km
- 3 Orbits planes
- Period 11hr 15min
- DEC. 64 Degrees
- Military System
GLONASS Modernization

GLONASS
1982 - 2007

GLONASS-M
2003 - 2015

GLONASS-K
2008 - 2025

GLONASS-KM
2015 - ……

Life-time 3 years

Life-time 7 years
2nd civil signal

Life-time 10 years
3rd civil signal

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Galileo

- Galileo is the European global satellite navigation system, providing a highly accurate, guaranteed global positioning service under civilian control.
CHINA BEIDO SYSTEM

COMPASS SATELLITE

- 24 MEO Satellites
- Similar to GPS/ GLONASS
- Encrypted Security Signal
- Same Frequencies as GPS or Galileo?
- Limited Information in The Public Domain
Satellite Positioning
How GPS works

The Earth is continually circled by 24 GPS satellites. At least four are always visible from any one point. Your GPS receiver listens for signals which give the satellites' location and the exact time of sending. Triangulation then gives your latitude and longitude to within 10m.
DIFFERENTIAL SYSTEMS
DIFFERENTIAL CONCEPT

Transmits pseudorange corrections
WIDE AREA AUGMENTATION

- Corrections available over a wide area
- Fewer Reference Stations
Other Initiatives

- WAAS
- EGNOS
- GAGAN
- IRNSS
- MSAS
- QZSS
- BEIDOU
- COMPASS

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<table>
<thead>
<tr>
<th>Navigation</th>
<th>Open Access</th>
<th>Commercial</th>
<th>Safety of Life</th>
<th>Public Regulated</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Free to air; Mass market; Simple positioning</td>
<td>High accuracy; Encrypted; Guaranteed service</td>
<td>Open Service + Integrity and Authentication of signal</td>
<td>Encrypted; Integrity; High continuity; Improved Robustness</td>
</tr>
</tbody>
</table>
Galileo Services

- Navigation
  - Free
    - Open Access
      - Simple
    - Open Service
      - Integrity
  - Encrypted
    - Commercial
      - Con. Integ. Precise
    - Public Regulated
      - Con. Integ
  - S&R
    - Return Lin
USER REQUIREMENTS

- Availability of the System
- Accuracy
- Reliability
- Continuity
- Accessibility
- Integrity
AVAILABILITY

GOOD Geometric Dilution of Position

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POSITION ACCURACY

GNSS (GPS/GLONASS/Galileo) – 5 m.

GPS / GLONASS - 15 m.

LORAN C - 180 m.

Transit - 200 m.

TACAN - 400 m.

Inertial - 1100 m.

Omega - 2200 m.
GNSS Navigation Application

Maritime Application

- Open Sea & Harbor
- Routing
- Automatic Identification System (AIS)
- Narrow channel Navigation
- Control of Dangerous Goods
- Container Tracking
- Mapping & Charting
- Hydrographic Surveying
- Pipes and Cable laying
- Buoying
- Dredging Control
Safety Critical Transportation
Precise Locations of Buoys
• Monitoring of Both Containers and Containerships

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AUTOMATIC IDENTIFICATION SYSTEM

AIS is mandatory system for Solas ships,

It enables ships to identify their Names, Particulars, Direction, Speed, Position and Intention Maneuvering.

Receive Automatically Similar Information from Ships Equipped with AIS.

Exchange Data with Shore

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Hydrographic Surface & Underwater Operations
NAVIGATION IN CONFIEND WATERWAYS
PORTS

- Approaches to ports and navigational channels
Monitoring of Vessels in Particular Routs
SPECIAL MARINE OPERATION

- Specifying Boundaries of dangerous and prohibited areas
Vessels Traffic And River Information Services

- VTS and RIS are shore based centers provide navigation services in approaches of Ports and Inland Waterways
Professional Applications

- Observing the changes of sea level
- Dredging operations
- Locating wrecks
- Laying pipe lines
- Salvage of sinking vessels
- Dynamic Positioning
- Positioning of oil rigs
- Fixing of Satellite sea launch platforms
Positioning Of Huge Offshore Platform
MEGA OIL RIGS

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Dynamic positioning

- Offshore platforms, floating drills and sea-base Satellite launching relay on GNSS-base dynamic positioning
Emergency Applications

- Emergency Position Indicator Radio Beacon EPIRB
SAR AND SURVIVAL OPERATION

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DISSASTERS

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MEDA COUNTRIES

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Egypt

- External maritime freight exceeds ports 54 million tons/year.
- 15 sea ports, 6 of them on Mediterranean and 9 on the red sea. Alex port is the largest port of Egypt.
- Suez canal is major important waterway for international shipping more than 18,000 ships passes the canal every year of an average of 40 vessels per day.
- VTS, AIS are implemented in Suez Canal Gulf of Suez Aqaba and in most Egyptian ports.
- Inland, River navigation comprises of passenger ships and barges. They are potential for GNSS monitoring based on VTS and AIS systems.
EGYPT CON.

VTS Installations in Egypt
- Gulf of Suez, VTS system
- Golf of Aqaba VTS system
- Suez Canal VTMIS

VTS for Egyptian Ports
Most of the Egyptian Maritime ports have VTS station (VTMS) to control and manage the port ships traffic.

AIS: Automatic Identification System

6 MARINE DGPS BEACONS ARE DEPLOYED ON MEDIT. AND RED SEA COAST
INLAND TRANSPORTATION

- The inland waterway network – which is a specificity of Egypt in the MEDA region is 1,500 km in length.
- There is a possibility to cover the entire river valley with additional DGPS beacons to assure safety of navigation.
Egypt GNSS Projects

- River Nile Bathymetry
- DGPS digital maps for safe Navigation System
- Potentials for real time tracking and monitoring.
- DGPS beacons to support satellite based positioning
ALGER

- Alger is dependent upon maritime transport for its external trade
- Pob., 32 mil., GDP about 54 Bill, per capita 1720$
- 11 Sea ports open to international traffic spread along 1200 km
- 8 of 11 ports exceeded one million tons cargo transport.
- 80% of Alger cargo are containerized
- Container positioning services is provided by (OR Bcomm) company.
- Ports are so fare not equipped nether AIS or VTS.
- EGNOS/GALILEO can provide added values for commercial and safety purposes.
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- One experimental DGPS is operational.
Turkish Ports have a leading turnover role in MEDA countries with over 130 million ton
Government and private operated ports (40)
AUIS, VTS are implemented in most of Turkish ports and AEEAN Sea and Black sea
Turkey also prepares to deploy DGPS, Beacons, however the system is not yet operated, but potential to be linked with EGNOS as and additional RIMS.
Maritime Galileo (MARGAL) project is to enhance the application of Galileo/EGNOS in maritime operation specially security and safety
Ports approach + docking
Inland water ways monitoring
Precise navigation
TWO DGPS BEACON TO BE OPERATED
Ports in Black Sea Turkish Strait Marimara Sea, Aegean sea and Medit. Sea ports are about 70 ports and terminals
MOROCCO

- SOLASA+SAR CONVENTIONS ARE RATIFIED BY THE GOVERNMENT
- VTS IN TANGIER JOINTLY OPERATED WITH TARIFA VTS IN SPAIN
- MOROCCO IS AN ACTIVE MEMBER OF MIDT.MOU FOR PORT STATE CONTROL
- AIS IS IMPLEMENTED IN THE APPROACHED OF MOROCCO PORTS
- VESSELES AND CONTAINER TRACKING BY GNSS(GPS SERVICES FOR CONTAINER LOCALISATION ARE DEPLOYED BY ORBCOM MAGREB).
- MAIN PORTS, CASABLANCA AGADIR NADOR AND
- JORF LASFAR
- Pop. 29 Mil., GDP 35Bill., per capita 1170$.
SYRIA

- TWO MAJOR PORTS IN SYRIA LATAKIA AND TARTOUS IN ADDITION TO OIL TERMINAL IN BAN YAS THEY ARE GOVERNMENT OWNED AND OPERATED
- BOTH PORTS ARE SOLAS, SAR AND CONVENTION RAIFIED.
- BOTH SOLAS AND SAR CON ARE RATIFIED
- TUNIS IS MEMBER OF MEDIT. MOU, PSC.
- 8 MAJOR PORTS, MOSTLY EQUIPPED WITH VST
JORDAN

- MEMBER OF MIDET. MOU FOR PORT STATE CONTROL
- THE MAJOR PORT OF AQABA INCLUDES PASSENGER AND FREIGHT CARGO
- THE PORT OF AQABA IS EQUIPPED WITH VTS AISSYSTEM
- THE COCEPT OF INTERMODAL TRANSPORT IS APPLIED
LEBANON

- LEBANN IS MEMBER OF SEVERAL IMO CONV.
- 4 PORTS BEIRUT, TRIPOLI, SAIDA AND SOUR
- 4-5 MILLION TONS OF FREIGHT ARE TRANSPORTED
- Pop. 4.4 Mil., GDP 17.6 Bill., per capita 3390$
• STUDIES ARE READY TO BE DEVELOPED IF PEACE TREATY IS REACHED BETWEEN CONCERNED PARTIES.

• GAZA PORT IS POTENTIAL TO MEET THE HUGE DEMAND OF INTERNATIONAL CARGO CREATED BY DENSE POPULATION OF PALESTINE.

• AT PRESENT THE PORT IS USED FOR FISHING BOATS.
MEDA COUNTRIES MARKET PLACE

POPULATION AND GNI per capita (2004)
Source UNDP

- Algeria: 32.4 million, 6.7 thousand USD
- Egypt: 72.6 million, 4.3 thousand USD
- Israel: 24.6 million, 6.6 thousand USD
- Jordan: 5.5 million, 4.9 thousand USD
- Lebanon: 5.5 million, 6.7 thousand USD
- Morocco: 31 million, 6.4 thousand USD
- Palestinian Authority: 3.5 million, 5.9 thousand USD
- Syria: 18.6 million, 3.6 thousand USD
- Tunisia: 10.7 million, 7.9 thousand USD
- Turkey: 72.2 million, 7.8 thousand USD

Colors: Population (in millions inhabitants), GNI per capita (PPP in thousands USD)
CONCLUSIONS

- GNSS should serve the navigation requirement
- GNSS should be reliable and of low user cost, distinction should be made between user for safety and users benefit in commercial terms
- GNSS Interoperable receivers are recommended
- Users should be timely informed of degradation of satellite performance (integrity)
- Galileo/EGNOS training and education programs should be available to maritime training institutes in MEDA countries.
- There is Potential Demand in MEDA Region on the services of EGNOS and Galileo.
CONCLUSIONS Con.

• Galileo/EGNOS systems will provide integrity monitoring along with suitable communications and information exchange between vessels and shore-based installations such as (VTS).

• The integrity monitoring concept works in a similar manner to (IALA) radio beacons and uses RTCM Messages over AIS to broadcast this information to shipping in MEDA region.
THANK YOU FOR YOUR ATTENTION