e-Navigation and the Internet of (Maritime) Things — Challenges and Opportunities —

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“Traditional” Business

- Maritime Safety Information (MSI)
- Meteorologic and Oceanographic Information (METOC)
Maritime Systems

- Stove piped systems
e-N@vigation

“E-navigation is 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.”.
e-NAV – Conceptual Model
e-NAV – System Architecture
e-NAV – Service Oriented Architecture

- Safety
- Security
- Environment Protection

Processes & Applications

Building Blocks

Service Bus

Data Fusion

Voice AIS ECDIS IRS/NAV ARPA LRI T VTS GMDSS

Web Service Web Service

External Services

Connection Services

Physical Links

Non-IP Services

IP Services

WWRS MF HF VHF

MF HF VHF SATCOM UMTS/LTE WiMax

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e-NAV – Information Users
e-NAV – M2M

Any Maritime "Entity" (Sensor, ROV, etc)
Maritime Eco-System
Ubiquitous Sensor Networks

Maritime Sensor Networks
Maritime Systems Networks
IoT
How does it fit in maritime business?
Four Layers Model for IoT & Io(M)T

- **Integrated Application**
  - Smart Logistic
  - Smart Grid
  - Green Building
  - Smart Transport
  - Env. Monitor
  - e-NAV

- **Information Processing**
  - Data Center
  - Search Engine
  - Smart Decision
  - Info. Security
  - Data Mining
  - Distributed Systems

- **Network Construction**
  - WWAN
  - WMAN
  - WPAN
  - Internet
  - WLAN
  - Cognitive Radio based Mobile Ad-hoc Networks

- **Sensing and Identification**
  - GPS
  - Smart Device
  - RFID
  - Sensor
  - Sensor
  - METOC Sensors
  - ROV
  - RADAR
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Sensing and Identification
- GPS
- Smart Device
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- Sensor

Others
- e-NAV
- Distributed Systems
- Cognitive Radio based Mobile Ad-hoc Networks
- METOC Sensors
- ROV
- RADAR
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Sensing and Identification
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- Sensor

Cognitive Radio based Mobile Ad-hoc Networks

Network Construction
- METOC Sensors
- ROV
- RADAR
Spectrum Challenges

- **MF/HF**: 3 KHz (< 9.6 Kbps)
- **VHF**: 25 KHz (DSC ↔ 9.6 Kbps)
- **VHF**: 8 VHF (# Mbps)
- **W-Fi / Wi-Max**: 24 KHz (< 64 Kbps)
- **SATCOM**: 6.66 (> 64 Kbps)
- **New Standards / Allocations / Assignments?**
- **New Assignments (Analogue TV?)**
- **New Allocations (ITU / WRC)**

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Maritime BLOS Spectrum Assignment
Enabling Technologies
“... all about physical items talking to each other..”
Challenges...other than technological...

How to convince the users of cooperative advantages of an Io(M)T?
Por te cruzarmos, quantas mães choraram,
Quantos filhos em vão rezaram!
Quantas noivas ficaram por casar
Para que fosses nosso, ó mar!
Quem quer passar além do Bojador
Tem que passar além da dor...
Obrigado!

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