

e-NAVIGATION - Options for Radio Communications

Introduction

At the first meeting of the IALA e-Navigation Committee, three fundamental elements were identified that should be in place before e-Navigation could be introduced. These are:

1. Electronic Navigation Chart (ENC) coverage of all navigational areas,
2. A robust electronic position-fixing system (with redundancy), and
3. An agreed infrastructure of communications to link ship and shore.

This paper looks at the factors affecting the development of maritime radio-communications, the technologies available and the applications.

The Committee is invited to consider using it as the basis for an input to the IMO Correspondence Group on e-Navigation.

e-Navigation Requirements

Communications will be essential to e-Navigation, in particular for integrating sources of navigation information and providing the user with the optimum, relevant data on a single display.

Driving Factors

- **Spectrum:** There is increasing pressure on the spectrum from commercial mobile telecom applications. Some administrations are promoting spectrum pricing as a method of improving spectrum efficiency. In particular radar designers are being pushed towards technology that will use less bandwidth and reduce spurious emissions. This will eventually free up spectrum and make possible alternative uses of adjoining bands.
- **Two-way Data Communication:** There is increasing demand for a common communication platform for two-way data communication between ship and shore.
- **Internet Access:** There is a growing requirement for Internet access on ships, at sea as well as in port.
- **Commercial pressures:** (e.g. 3G providers) commercial providers are increasingly anxious to find markets for their services. This may provide opportunities for new ways of communicating and presenting navigation information to the user.
- **Non-safety related communication:** there are commercial pressures on systems developed for safety purposes, e.g. messaging on AIS
- **MF/HF data exchange:** ITU is developing technical requirements for MF/HF data exchange services as a possible alternative to NBDP (radio telex) and has also initiated studies on VHF digital technology.

Candidate Technologies

- **IP Networks:** New services are envisaged for the broadcast over IP networks of Maritime Safety Information (MSI), using HF and satellite services such as Inmarsat BGAN (Broadband Global Area Network). Other IP network systems might also be applicable.

- **UWB (Ultra Wide Band):** Spread spectrum applications include short range radars and wireless networks. This technology presents opportunities, but may also pose a threat to existing services, since it raises the noise level.
- **Digital radio technology** (including CDMA and TDMA): applicable to many uses in maritime data communication, where spectrum is scarce and error-free communication is required. At the same time discussions are taking place regarding the possible sub-division of maritime mobile communication bands, especially VHF.

Maritime Applications

- Communication
 - AIS:
 - ITU has assigned two VHF frequencies, 161.975 MHz and 162.025 MHz worldwide for AIS purposes on a primary, non-exclusive basis. Interference problems in some parts of the world have indicated that more protection may be required.
 - There is increasing pressure to utilise AIS for non-safety related messages thus potentially overloading the AIS channels. This type of communication is important but may need additional channels or alternative communication methods than AIS.
 - Long Range Identification and Tracking (LRIT)
 - The Maritime Safety Committee at IMO has selected IMSO as the LRIT Co-ordinator to perform review and audit of the LRIT System. Inmarsat C equipment already fitted to satisfy GMDSS requirements will, in most cases, be able to satisfy LRIT requirements. However, older Inmarsat C equipment may require hardware or software upgrades (or may need to be replaced). Other satellite communications equipment and certain secure terrestrial communications may also meet LRIT communications requirements.
 - Although not LRIT as defined in SOLAS, trials are taking place in several countries on the feasibility of receiving AIS reports on Low Earth Orbit satellites.
 - SAR Search and Rescue applications need priority and have internationally agreed allocations in MF, VHF, UHF and L Band. The moves towards spectrum marketing by some administrations will need to take this into account if it is not to lead to serious degradation of SAR services and consequent risk to life.
 - VTS
 - VTS-stations handle a large amount of voice traffic on several different VHF-channels. The problem is the severe lack of free VHF-channels, increasing VHF-traffic and new VHF service requirements. The situation is particularly bad in areas of overlapping coverage from different VTS-areas and different countries. The introduction of AIS may reduce the need for VTS VHF voice traffic.

- NAVTEX Discussions are taking place on the future of NAVTEX. The development or eventual replacement of NAVTEX will have an effect on maritime services and available spectrum.
- GMDSS The long gestation period of GMDSS saw many problems with training and false alarms. These appear to have been addressed by maritime administrations, but there is likely to be continuing pressure for improvement.
- SafetyNet: This is a Maritime Safety Information service provided by Inmarsat and would be a possible replacement for NAVTEX.
- Maritime Voice Communication on VHF: The main development here is likely to be reduced channel spacing and the move towards digital technology
- Maritime Data Communication: the demand for two-way data communication between ship and shore could be met by a number of different technologies, but will need international standardisation.

Table contributed to Gap Analysis for IMO CG

Communications Support			
Aspect	Today	E-Navigation	Issues
<i>Production</i>			
Between systems onboard, Ship to ship/ship to shore/shore to shore	UHF/VHF MF/HF AIS Inmarsat services VSAT	WiFi AIS/LRIT Inmarsat Broadband VSAT	Congestion, interference, licensing, spectrum pricing
<i>Capabilities</i>			
Capacity, reliability, coverage	Limited use onboard Coastal use subject to congestion Long range expensive	Unlimited use onboard Coastal and long range reporting automatic Continuous internet	Spectrum limitations, competition for spectrum
<i>Standards / certification</i>			
Technical characteristics Performance requirements Equipment standards & testing	ITU-R IMO IEC	ITU-R IMO IEC	Long timescales for standardisation
<i>Security: Confidentiality/Integrity/Availability</i>			
Interference, interception,	Mainly analog systems	Digital (error detection & correction possible)	Need for/desirability of encryption
<i>Liability</i>			
Incorrect information, wrong use of information, deliberately misleading information	National legislation	International convention	Commercial use of AIS data
<i>Regulations</i>			

Mandatory carriage	GMDSS	Broadband internet	Use of public networks rather than dedicated links
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