RESEARCH & RADIONAVIGATION
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The Strategic Case for eLoran

Background

In 2007, at the instigation of several member administrations including the UK and US, the International Maritime Organisation (IMO) agreed to develop e-Navigation as the future digital concept for marine navigation. The IMO Maritime Safety Committee stated that: 'e-Navigation systems should be resilient …. robust, reliable and dependable. Requirements for redundancy, particularly in relation to position fixing systems should be considered.' [1]

Recent analysis by the IMO e-Navigation Correspondence Group has shown that almost all the many applications of e-Navigation on ships and on shore will simply not be viable without a robust positioning system. Reliance on Global Navigation Satellite Systems (GNSS) alone – effectively GPS and GLONASS at present - would leave e-Navigation vulnerable to interference, both accidental and deliberate. Its introduction, far from enhancing safety, might actually reduce it.

Introduction

eLoran is a low frequency (100 kHz) radio-navigation system using high-powered, long-range transmitters. The pulsed signals provide accurate positioning for all modes of transport as well as precise timing for telecommunications and other systems. eLoran is an ideal complementary backup to satellite navigation systems such as GPS, which are highly vulnerable to interference and jamming because of the extremely weak signals that reach their receivers. New GNSS systems, such as Galileo, QZSS and Compass, employ similar power levels and frequencies to GPS and so share this key vulnerability. eLoran, being a low-frequency, high power, terrestrial system, is completely independent of satellite navigation with which it shares no modes of failure. Yet it can do most of the tasks GPS does.

eLoran has been developed from the obsolete Loran-C system, by changing to solid-state transmitters, using precise timing and adding a digital data channel to provide correction and integrity messages. The result is a robust and accurate 21st-century technology for position, navigation and timing use. Loran-C stations, ready for updating to eLoran, are already in place in some 16 countries worldwide, in Europe, Russia, the Far East, Middle East and North America. Although the transmissions in the US and Canada have been switched off pending a decision on the stations' future, the sites remain ready for conversion to eLoran, using high-efficiency unattended transmitters.

A prototype eLoran service is already being operated continuously in the UK, as part of a European network, for evaluation and development purposes. The Republic of Korea has recently announced its intention to provide eLoran across the whole of its landmass and coastlines. There is also a service in the Port of Rotterdam.

National implications

Many industrialised nations have become highly dependent on GPS which was for several years the only fully deployed GNSS. GPS has become the primary means of navigation for ships and is at the core of future plans for aviation. It is integral to most land navigation, including emergency services, essential for surveying and widely used in agriculture and asset management. It serves as the timing reference in telecommunications systems, for financial transactions and in many other applications. GPS is now embedded in almost every part of industry and commerce.

GPS has become a crucial element of critical national infrastructure, in many cases without any backup being provided. The loss or interruption of GPS has very serious operational, financial and safety implications, unless appropriate fall-back systems are provided or alternative procedures are in place, something no longer feasible in many applications. Integration of eLoran into GNSS receivers can mitigate this risk at minimal extra cost to the user.

International maritime implications

The International Maritime Organisation is developing a Strategy Implementation Plan for e-Navigation and there is general agreement that some form of backup to GNSS will be needed. Since e-Navigation is likely to be implemented from 2018, it appears that eLoran is the only proven candidate available within the timescale. Already the ability of ships to revert automatically and seamlessly to eLoran on the loss of GPS has been demonstrated. The existing Loran infrastructure covers some 70% of the world's major shipping routes and ports, so eLoran could readily be implemented as a backup in many areas of high traffic density or high risk.

Benefits

However, the benefits of eLoran extend far beyond the shipping industry. eLoran is already providing a backup for precision timing across the UK and Ireland. This greatly reduces vulnerability to the loss of timing in telecommunications, the energy industry and financial trading. The UK eLoran signals also carry a secure and robust data service for certain national critical communications. eLoran has the potential to back up the tracking and monitoring systems widely employed for management and security in land transportation. In short, eLoran greatly reduces the vulnerability of critical national infrastructure to interruption by natural phenomena, such as space weather, and deliberate or accidental interference from other radio signals [2].

Conclusion

A terrestrial backup to GNSS, independent of satellite systems yet compatible with them, is needed to mitigate dependence on vulnerable GNSS for a wide range of critical infrastructure systems. For shipping, eLoran is the only candidate realisable within the timescale for the implementation of e-Navigation.

Most of the infrastructure for eLoran is already in place in many countries and an operational trial system is already demonstrating the required levels of service [3].

References:

[1] IMO Maritime Safety Committee, 2009. MSC 85/26, Annex 20.

[2] Williams et al, *"eLoran IOC implementation (Port of Dover installation)"*, General Lighthouse Authorities of the UK and Ireland, 11 Oct 2012

[3] Global Navigation Space Systems: reliance and vulnerabilities, The Royal Academy of Engineering, ISBN 1-903496-62-4, March 2011.