MARITIME REPORTER AND ENGINEERING NEWS

Tel 352 692 5493
Fax 352 692 5494

Dennis L. Bryant
Bryant's Maritime Consulting
4845 SW 91st Way
Gainesville, FL 32608-8135

May 2015

Rising from the ashes

Dennis L. Bryant

The federal government is now taking steps to reverse its 2010 decision to terminate the nation's LORAN program.

The LORAN program was initiated during World War II, when US and Allied forces fighting in the Pacific Theater needed a good means of navigation in that vast ocean. The US Coast Guard was charged with establishing and operating chains of Loran-A stations throughout the Pacific. With war's end, the program was extended to coastal areas of the United States and elsewhere. Over time, Loran-A was replaced by Loran-C, which provided both greater coverage and improved accuracy. As part of the digital revolution, the Coast Guard in about 2000 began exploring the possibility of developing an enhanced version of Loran, soon referred to as eLoran.

In an effort to reduce the hemorrhaging federal deficit, the Administration's Budget for 2010 proposed termination of the Loran program, using these terse words: "*The Budget also supports the termination of outdated systems such as the terrestrial-based long-range radionavigation (LORAN-C) operated by the U.S. Coast Guard resulting in an offset of $36 million in 2010 and $190 million over five years.*" Although only the bean counters thought that this was a good idea, the Department of Homeland Security and the U.S. Coast Guard bit their respective tongues and went along, as did Congress. Thus, Loran-C was terminated as was work on developing eLoran.

Similar to Loran-A and Loran-C, eLoran is a low frequency terrestrial navigation system utilizing a number of transmission stations that emit precisely timed and shaped radio pulses. In eLoran, the pulses are centered at 100 kHz. Each station emits a sequence of eight pulses spaced 1000 microseconds apart. The stations are grouped into chains, each consisting of one master station and two or more secondary stations. The master station transmits first, followed by successive transmissions from each of the secondary stations of the chain. The master/secondary transmission sequence is repeated periodically, with the period between repetitions referred to as the Group Repetition Interval (GRI).

Unlike the hyperbolic Loran-C system, modern eLoran receivers can simultaneously measure the "time of arrival" of signals from many stations in multiple chains. Using solid-state transmitters and atomic clocks, eLoran provides extremely precise timing. The transmitters also

E-mail dennis.l.bryant@gmail.com
Internet http://brymar-consulting.com/

provide a data channel carrying correction and integrity messages. Using built-in microprocessors, eLoran receivers output latitude and longitude directly, eliminating the need for Loran-line charts.

The eLoran system operates in much the same way as GPS or other global navigation satellite systems (GNSS), but as a complementary and independent system. There are no failure modes in common with GNSS systems. Operating at significantly higher power than satellite-based systems, eLoran is much more difficult to jam or spoof.

Since at least 2004, studies have pointed out the nation's (and indeed the world's) increasing reliance on GPS and other GNSS for positioning, navigation, and timing (PNT). Surveyors, farmers, and others rely on GPS to accomplish many of their tasks. Modern transportation networks rely on GPS for their operation and safety. Modern communication, financial, and power networks could not operate without the precise timing provided by GPS.

Of the 16 commercial sectors identified as vital to the nation's economy, security, and health – referred to as critical infrastructure sectors – at least eleven rely extensively on GPS. GPS technology and GPS-supported applications are deeply embedded into the fabric of our modern lives. Computers, cellular telephones, automatic teller machines (ATMs), and electronic chart display and information systems (ECDIS) would all cease to operate properly without the PNT output available from GPS.

While GPS is taken for granted, it is a relatively recent development and it is highly vulnerable. Solar flares and other high-energy electromagnetic fields (natural or man-made) can temporarily or permanently disrupt transmissions. Terrestrial or airborne transmitters can jam or block reception of satellite signals over wide areas. Due to the lower power of the satellite signals, receivers can be spoofed or fooled into accepting and utilizing bogus signals.

The Government Accountability Office (GAO) reported that there are significant concerns about the sufficiency of efforts of the critical infrastructure sectors to mitigate the expected adverse effects of GPS signal loss. Other studies have shown that the only reasonably available mitigation technology to address GPS signal loss is eLoran.

The federal government seems to be finally awaking from its self-induced slumber on this vital issue. On 23 March 2015, the Department of Transportation (DOT) published a notice seeking public comments regarding potential plans by the government to implement eLoran as a complementary PNT capability to GPS. On 27 March, Representative John Garamendi (D-CA) introduced the bipartisan National Positioning, Navigation, and Timing (PNT) Resilience and Security Act of 2015 (H.R. 1678). If enacted into law, the bill would require the Secretary of Defense, in coordination with the Commandant of the Coast Guard and the Secretary of Transportation, to provide for the establishment, sustainment, and operation of a reliable, land-based positioning, navigation, and timing system to provide a complement to and backup for GPS to ensure the availability of uncorrupted or non-degraded PNT signals for military and civilian users if GPS signals are corrupted, degraded, unreliable, or otherwise unavailable.

The General Lighthouse Authorities of the United Kingdom and Ireland (GLA) has never given up on eLoran. Rather, since 2007 it has constructed transmitter sites and conducted at sea tests to determine the accuracy and robustness of the system. In partnership with other European nations, there are now nine operational transmitters providing coverage for northwest Europe. The Russians have converted their Chayka radionavigation system to broadcast a signal that is compatible with eLoran.

Only time will tell if the legislative and executive branches of the federal government have the political will to move forward on this vital and long-overdue initiative. The technology is readily available, but it will take determination to move these first tentative steps to reality. Scarce monies will have to be appropriated. Priorities will have to be rearranged. While the government has imposed a number of resilience requirements on the private sector, it has omitted to take one important step of its own. Movement is now being made to rectify that oversight.

In mythology, the phoenix is a long-lived bird that is cyclically regenerated or reborn. A phoenix obtains new life by arising from the ashes of its predecessor. The allusion fits the situation with Loran. Loran-A gave birth to Loran-C. After its death, Loran-C may be about to give birth to eLoran.