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Issue Date: May/June 2008, Posted On: 4/14/2008

Loran to become eLoran

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The reliable, accurate and (relatively) cheap loran radio-navigation system got a new lease on life in February when the Department of Homeland Security announced support for a new flavor of loran called "eLoran" (enhanced loran). This improved version of loran can provide navigators with eight- to 20-meter accuracy and make it a great partner to GPS.

This positive news for loran (the name loran comes from the term "long-range navigation") should put to rest several years of speculation about the future of the system. Even though the Federal government spent millions in the 1990s to update the loran system and to build more stations to fill the mid-continental gap in coverage, there was speculation that perhaps loran was not needed in the age of GPS. In May 2000 when the Defense Department turned off selective availability — the name of the program that denied full GPS accuracy to civilian users — it was a GPS world.

GPS products and applications were everywhere and loran was looking a bit dowdy in comparison. Then in 2003 the European Union formally agreed to develop its own version of GPS, called Galileo. According to EU press releases, Galileo would put another 24 satellites in orbit, and would be interoperable with GPS, giving satellite navigation users 48 birds from which to get a fix. Given these developments, the Coast Guard began to make noises about turning off loran as a way to cut costs. Who needed clunky, old land-based loran when it seemed like a satellite future?

But as good as GPS is, relying solely on GPS has a drawback. What if GPS is unavailable? GPS users in need of either an electronic navigation fix or precise timing data are in trouble if they can't get a GPS signal. Rather than shut loran down, some observers, most notably former FAA Administrator Langhorne Bond, raised the point that maybe the Federal government should update loran — make it more GPS-like.

Various ideas for improving loran have been developed over the years by the Coast Guard's Research and Development Center and by the Department of Transportation. Some of these ideas come together in the eLoran system. The result is improved absolute accuracy for navigation, better fix reliability, and precise time for tasks like switching cell phone networks. "For both timing users and navigation users there is a higher level of integrity using eLoran," said Zachariah Conover, president of CrossRate Technology, an eLoran/GPS receiver company in Standish, Maine.

There are three main aspects of eLoran that make it different from the way loran is presently operated: 1. the timing of the broadcasts, 2. the addition of corrections to the signal, and 3. a different scheme for monitoring and control.

The type of loran we relied on the 1980s and early 1990s before GPS took over was a system built around chains (e.g., the 9960 Northeast chain, the 9940 West Coast chain). This loran system went into operation in 1980 and was dubbed loran C by the Coast Guard (loran A was an earlier, higher frequency/shorter range system; loran B was never deployed). In the chain setup, a master station broadcasts a set of pulses and the other stations in the chain, called the secondary stations, then broadcast their pulses in a set sequence. The time, measured in microseconds, required for the whole chain to broadcast their pulses is called the group repetition rate (GRI). The master station has cesium atomic clocks that allows it to precisely control the time of its broadcast. The secondary stations take their cue from the master, broadcasting their pulses in their preordained sequence called a coding delay. Chain control is done via system area monitors (SAMs) that track the signals from a chain and make slight corrections to compensate for seasonal effects. Thus, a user's receiver tracks the GRI of a chain and then uses the signals from the stations in the chain for determining position.

ELoran, however, takes a different approach for determining when a station transmits its signal. "With eLoran you go from SAM control to Time Of Transmission [TOT] control," said Conover. Each station has cesium atomic clocks on site (all loran stations have had cesium atomic clocks since about 2002) and using these clocks, each station broadcasts its pulses based on Universal Coordinated Time (UTC), rather than using the GRI coding delay and/or any timing changes ordered by the SAMs.

The result is a "chainless" system, without masters and secondaries. In this type of system a receiver can use the signals from any station in range, no matter what its location. This approach greatly increases the number of stations available. Instead of using three stations in a chain (the master and two secondaries), an eLoran receiver might have 10 stations it can use.

This timing change is currently being tried by the Coast Guard's Loran Support Unit (LSU). "Time of transmission is undergoing testing right now on the 9960 Northeast chain and the 8970 Great Lakes chain," said Commander Christopher Nichols, commanding officer of the LSU.

Another major improvement in eLoran is a change to the signal structure of the secondary stations. In the classic loran C setup, secondary stations broadcast a series of eight pulses when it's their turn to transmit. Now, however, all eLoran stations will send nine pulses each time they broadcast (master stations have always sent a ninth pulse, but it was used for other purposes). Older, non-eLoran receivers will still be able to get a fix from the new system. Essentially, they won't see the ninth pulse.

This new ninth pulse will transmit useful data to eLoran receivers, including signal corrections, timing data and an error correction component. This message will be 120 bits in length with five bits sent each GRI. Thus, the entire message is sent 24 x GRI and the maximum time required to send the entire 120-bit message would be approximately 2.4 seconds. So, roughly every 2.4

seconds you could have new signal correction data that allows your eLoran receiver to correct for signal errors. This is similar to the differential approach used in the FAA's Wide Area Augmentation Service (WAAS) GPS correction scheme that most current GPS receivers use to improve GPS accuracy. It is these signal corrections that allow eLoran accuracy to get down to the eight to 20 meters required for harbor navigation.

The third element needed for eLoran is improved signal monitoring, which means more monitor stations. "The current SAMs could be used," said Nichols. "But they are insufficient to cover all the areas needed in an eLoran system, both for harbor approach and for aviation."

The real benefits of eLoran come from a combined GPS/eLoran unit that can get a fix using either system. With a combined receiver, users will have a real "belt and suspenders" of a back-up system should either system become unavailable. CrossRate Technology has developed a combined eLoran/GPS receiver called the eLGPS1110.