

# Loran Gets a Witness

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GPS World

The Radio Technical Commission for Maritime Services (RTCM) has joined more than 900 other organizations and individuals in responding to the [request for comments](#) on Loran. RTCM comments verbatim:

RTCM's Board of Directors has adopted a position in support of maintaining the Loran-C system, and its modernization to e-Loran standards. Loran provides an important backup to the Navstar Global Positioning System (GPS) and other Global Navigation Satellite Systems (GNSS), not only for position and navigation purposes, but for timing applications as well. In deciding on this position, RTCM has taken the following into consideration:

**GPS/GNSS augmentation:** The accuracy of GPS/GNSS systems is improved by the availability of additional satellites. In a combined GPS/Loran receiver, Loran signals can function like an additional satellites, thereby improving positional accuracy. Combined GPS and Loran receivers are currently available, and the accuracy provided by the envisioned e-Loran system will enhance their usefulness.

**Vulnerability of signals:** The signals from GNSS satellites are very weak at the earth's surface. Although it is difficult, jamming of civil GNSS signals is possible. Loran's stronger signal makes jamming more difficult. The following is from the 2005 Federal Radionavigation Plan:

## 1.6.2.1 Vulnerability of GPS in the National Transportation Infrastructure

The Final Report of the President's Commission on Critical Infrastructure Protection concluded that GPS services and applications are susceptible to various types of radio frequency interference, and that the effects of these vulnerabilities on civilian transportation applications should be studied in detail.

**Shielding is another potential issue.** Loran's stronger signal would enable land navigation and tracking systems to continue to operate with a combined GNSS/Loran receiver in some places such as tunnels and areas of dense vegetation, where GNSS reception is shielded.

**Vulnerability of satellites:** As has been recently demonstrated, satellites may be vulnerable to destruction by a future adversary. Loran stations are land-based, and easier to defend. Should the GNSS system be compromised as the result of a conflict, Loran receiver input to shipboard systems such as the Automatic Identification System (AIS) and Long Range Identification and Tracking (LRIT) System, would enable those systems to continue to function. Both systems are considered essential to maritime security, a

concern that would certainly take on added importance in a time of conflict. Recent experiments have shown e-Loran capable of meeting Harbor and Harbor Entrance positioning requirements.

Loran is needed as a reliable backup to GPS for timing purposes. Modern communications systems (e.g. cellular telephone) depend on timing derived from GPS and/or Loran, and would not be able to function without them.

**Legacy users:** Many recreational boaters and smaller commercial vessels have Loran-C receivers, which provide them with sufficient navigational accuracy for their purposes. Termination of Loran-C service would render their equipment useless and their investment in it would be lost. Many commercial boat operators use both GPS and Loran-C, and consider Loran-C a vital supplement to GPS. They are quite familiar with periods of GPS unavailability, and charter boat operators have to use Loran-C under those conditions to find wrecks, rocks, or reefs for fishing or SCUBA diving.

**International compatibility:** Loran providers in Europe, Asia, and the Middle East have committed to continuing Loran service. The United States needs to commit to Loran in the interest of a seamless international position, navigation, and timing service.

For the Radio Technical Commission for Maritime Services,

— *R. L. Markle, President*

## **Sprint Nextel Chimes In**

Further verbatim comments:

Sprint Nextel Corporation respectfully requests that the U.S. Government continue to operate and invest in the LORAN-C and eLORAN systems. Should the DOT and DHS decide to decommission the LORAN-C system, Sprint Nextel recommends that the agencies delay doing so until the eLORAN system is fully operational. Sprint Nextel and other communications providers use the frequency signals of the Global Positioning System ("GPS"), LORAN, and atomic clocks for multiple levels of redundancy and diversity in their networks. Therefore, Sprint Nextel urges the DOT and DHS to carefully weigh decisions which might impact LORAN's availability to the Nation's voice and data communications networks.

### **Background**

The primary mechanism that Sprint Nextel uses to receive an accurate frequency reference for its data and voice networks is reliance on a radionavigation receiver specially modified for timing (i.e., frequency) instead of position. This is known as a "primary frequency reference source" or "PRS." A PRS provides a frequency signal with an accuracy of 1 part in 10<sup>11</sup> or better. This frequency is then distributed throughout the network. Before GPS was available, LORAN-C was widely used as a PRS.

The loss of a PRS can negatively impact a telecommunications network, and those impacts can vary from minor short-term noise impairments to long-term network-wide outages. Both traditional wireline services and newer wireless services require a precise frequency reference for basic service delivery and Universal Time Coordinated time-of-day for less critical capabilities. Physically, the continental United States portion of the Sprint Nextel network requires a PRS at thousands of switch sites, interconnection sites, and cell tower sites to ensure reliable service delivery.

As the full potential of GPS services and its augmentations are implemented, the demand for other radionavigation systems, specifically, LORAN-C and eLORAN, will likely decrease. However, GPS remains vulnerable to certain types of disruptions. Therefore, "it is the policy of the U.S. Government not to rely on a single-system for positioning, navigation, and timing."

## **Discussion**

### **1. Sprint Nextel believes that the U.S. Government should continue to operate and invest in the LORAN-C**

A previously conducted study by the DOT, in consultation with DHS, found that GPS has multiple vulnerabilities. Among other things, GPS is susceptible to interference because of the low power of the signal. Intentional interference, or jamming, is a well-documented problem and the cause of great concern. Second, GPS is susceptible to spoofing, which is a technique intended to cause a GPS receiver to lock on false signals that appear to be legitimate. Third, GPS is a line-of-sight system that works poorly indoors. Fourth, the GPS receiver output may become invalid for various reasons, ranging from human error such as a technician leaving a cable disconnected, equipment failures, vandalism, or an act of God in the form of a lightning strike. Finally, the United States government reserves the right to disable GPS in the event of a national emergency.

The report also stated that care must be taken to ensure that adequate back-up systems or procedures can be used when needed.

From a physical perspective, LORAN and GPS have very different characteristics: ground vs. satellite based, low vs. high frequency, high signal level vs. low signal level. Consequently, they do not suffer from the same modes of failure, and each likely will be available or provide better performance under conditions where the other system might be compromised. In other words, LORAN and GPS are complementary systems and, as a result, are very useful for providing redundancy.

Accordingly, Sprint Nextel, along with other telecommunications carriers, uses LORAN-C to back-up GPS in its wireline voice and data networks in the case of a GPS failure. In a wireline telecommunications network, a short GPS outage will have only a minor impact on the network if an ample holdover mechanism is in place. However, in the event of a long or permanent GPS outage, or in the event that a GPS signal was jammed, the only solution for telecommunications carriers to employ is a redundant PRS technology,

such as LORAN. Sprint Nextel has found that LORAN-C consistently demonstrates the ability to meet the frequency performance requirements of a PRS in a wireline telephone network.

Although Sprint Nextel's networks can operate without LORAN, during a long GPS failure, its networks would begin to experience service degradation without the backup that LORAN provides. In terms of voice and "real-time" data applications such as Voice over Internet Protocol ("VoIP") and streaming video, the end-user would experience clicks or pops on the VOIP service, and retransmitted IP data packets or pixelization on the video service. Initially, the service will degrade slowly, but the effects would worsen at an accelerating rate. At about 21 days after the loss of GPS with no LORAN backup, quality impacts will be 10 times worse than on day one. At 60 days, impacts will be 10,000 times worse, with severe hits to telecommunications networks, including the likely inability to place traditional circuit-switched voice calls.

The DOT and DHS also must not ignore the fact that decommissioning LORAN might have profound ramifications well beyond those affecting a single user group. For example, commercial and general aviation air traffic, car and train navigation, small and large vessel marine operations, and millions of telecommunications users could be simultaneously affected by a GPS failure. Thus, Sprint Nextel believes that LORAN is an excellent complement to GPS, and that combining GPS with LORAN would provide a hybrid national radionavigation system with capabilities much better than GPS alone, regardless of how many GPS augmentations can reasonably be implemented.

## **2. Sprint Nextel believes that the U.S. Government should continue to invest in eLORAN.**

eLORAN is a modernized version of the preexisting network that features signals with improved timing capability. eLORAN also adds the timing capabilities that allow it to better meet the time synchronization requirements of a CDMA wireless network and it could potentially support future networks with sub-microsecond synchronization requirements.

While Sprint Nextel does not support the decommissioning of the LORAN-C system, if DOT and DHS decide to do so, Sprint Nextel believes that eLORAN, with its large coverage area and its high level of performance, can provide telecommunications carriers in the U.S. with the synchronization redundancy that they need to keep their networks fully operational in the absence of GPS. Under no circumstances, however, should the U.S. Government place total reliance on GPS and completely abandon its plans to continue to deploy eLORAN.

## **Conclusion**

Sprint Nextel believes that GPS is a remarkable system and that it should constitute the foundation of our national radionavigation infrastructure, however, under no circumstances should it be deemed the only technology. Today, LORAN provides an

independent, redundant system that has no common mode failures with GPS, can be used in dense urban environments, and is a proven technology with an established user base. With no such redundancy, telecommunications consumers could be adversely affected. Thus, DOT and DHS should retain the LORAN system, or at a minimum, ensure that eLORAN continues to be available as a back-up system for providing both a precise frequency suitable for use as a telecom PRS and UTC time-of-day functions. Most importantly, a combined GPS and LORAN system outperforms what GPS can do alone.

The U.S. Government should therefore continue to recognize and support LORAN as an important complement to the functioning of GPS.