Paper 27

THE LOW-FREQUENCY ALTERNATIVE TO SATELLITE-BASED TIMING SOLUTIONS

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Abstract

The Global Positioning System (GPS) has become the sole means in many instances for obtaining crucial timing signals. GPS provides the necessary timing performance levels and there are a myriad of low-cost, single-purpose GPS receivers on the market. However, GPS, and in fact any Global Navigation Satellite System (GNSS) or Regional Navigation Satellite System (RNSS), is vulnerable to both intentional and unintentional interference, jamming, and spoofing. Whether it is simple unavailability, or outright denial, the results are wide-ranging: service degradation, complete outages, sporadic and unpredictable unavailability, or incorrect information.

As an alternative to satellite-based timing solutions, we focus on providing a timing service using high-power, Low Frequency (LF) signals. Because of its long propagation range, the ability to measure the arrival time of a pulsed signal with great accuracy, and a well-defined ground wave signal propagation path, an LF solution is an attractive terrestrial-based alternative to a low-power, high-frequency, satellite-based signal.

Under our Cooperative Research and Development Agreement (CRADA), UrsaNav has access and use of the transmit facilities and radio spectrum formerly assigned to the transmission of Loran-C in the USA (90-110 kHz). We have taken this opportunity and invested in developing, implementing, and testing, new transmitter and receiver technology, using new and optimized RF waveforms occupying the same spectrum. We have already demonstrated that our receiver performs to Stratum-1 levels and meets the International Telecommunication Union (ITU) requirements for Primary Reference Clocks (PRCs) In telecommunication networks over distances up to 1,000 miles.

In our presentation, we will provisionally address:
- Test results and capabilities of our newest timing receivers as measured at various geographical locations
- Performance of our latest receiver, including live demonstrations during the conference
- Test results of Two-Way Low Frequency Time Transfer (TWLFTT)
- Properties and test results of our latest RF waveform for positioning and timing, which we call 'Almond Code'