

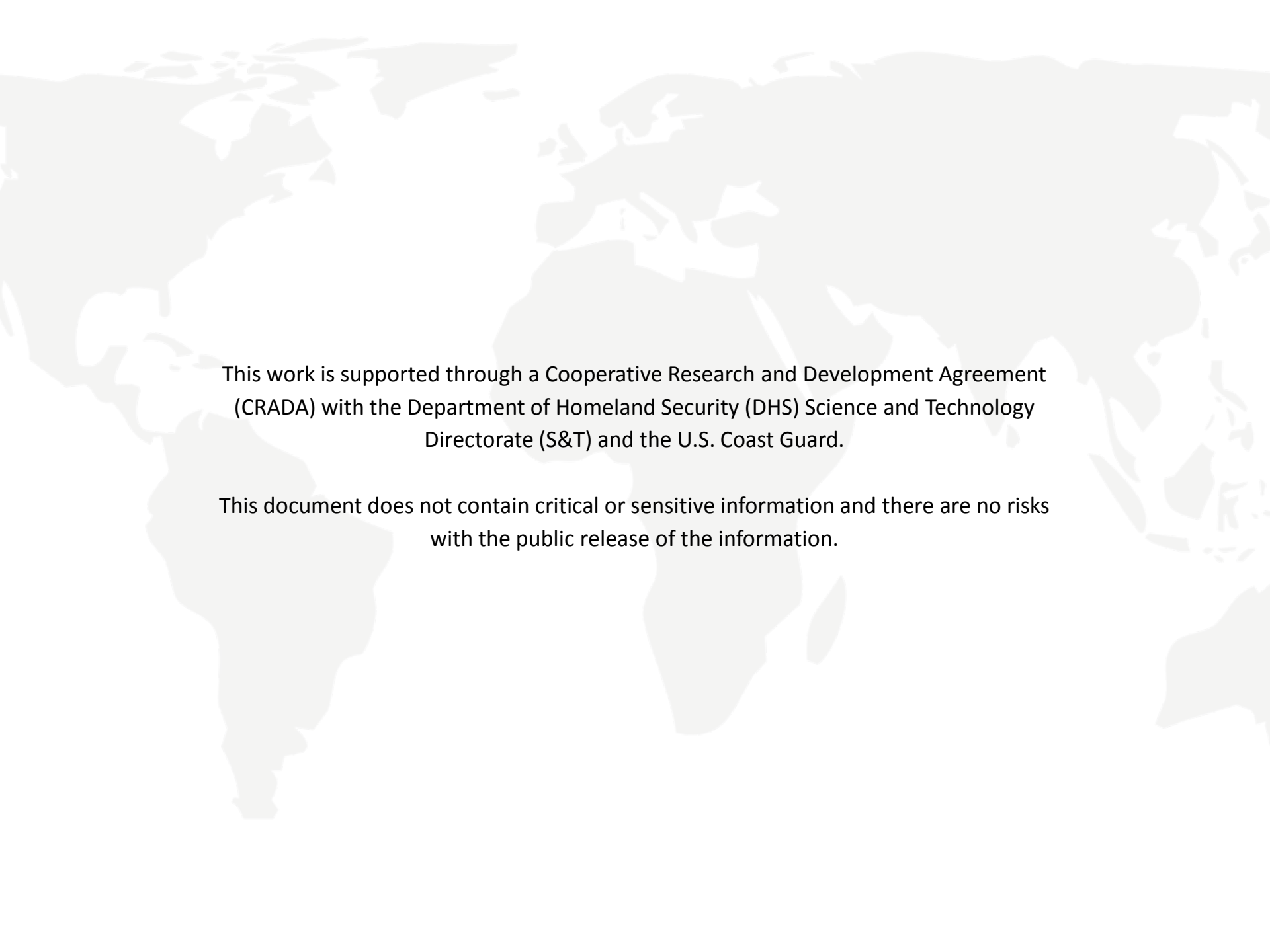


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CRADA2 Timing Data Updates



This work is supported through a Cooperative Research and Development Agreement (CRADA) with the Department of Homeland Security (DHS) Science and Technology Directorate (S&T) and the U.S. Coast Guard.

This document does not contain critical or sensitive information and there are no risks with the public release of the information.

Evaluate: eLoran as a Wide Area Timing Source

- Transmissions from former USCG Loran Support Unit site at Wildwood, NJ
 - 360 KW Effective Radiated Power
 - TWSTT UTC reference from the USNO

- Receivers
 - Bangor, ME
 - N. Billerica, MA
 - Columbus, OH [Note: new receiver location.]
 - Washington, DC (USNO)
 - Leesburg, VA

- Technology
 - Outdoor E-Field antenna
 - Loran Data Channel (LDC) demodulation available
 - GPS and/or 5071A PRS used as timing comparison
 - Without differential corrections

- Criteria
 - Meet one microsecond 2014 FRP Timing User Requirement

eLoran Timing Evaluation Technology Laydown

LSU Wildwood, NJ to (miles)

USNO, DC: 120

Leesburg, VA: 140

N. Billerica, MA: 310

Columbus, OH: 440

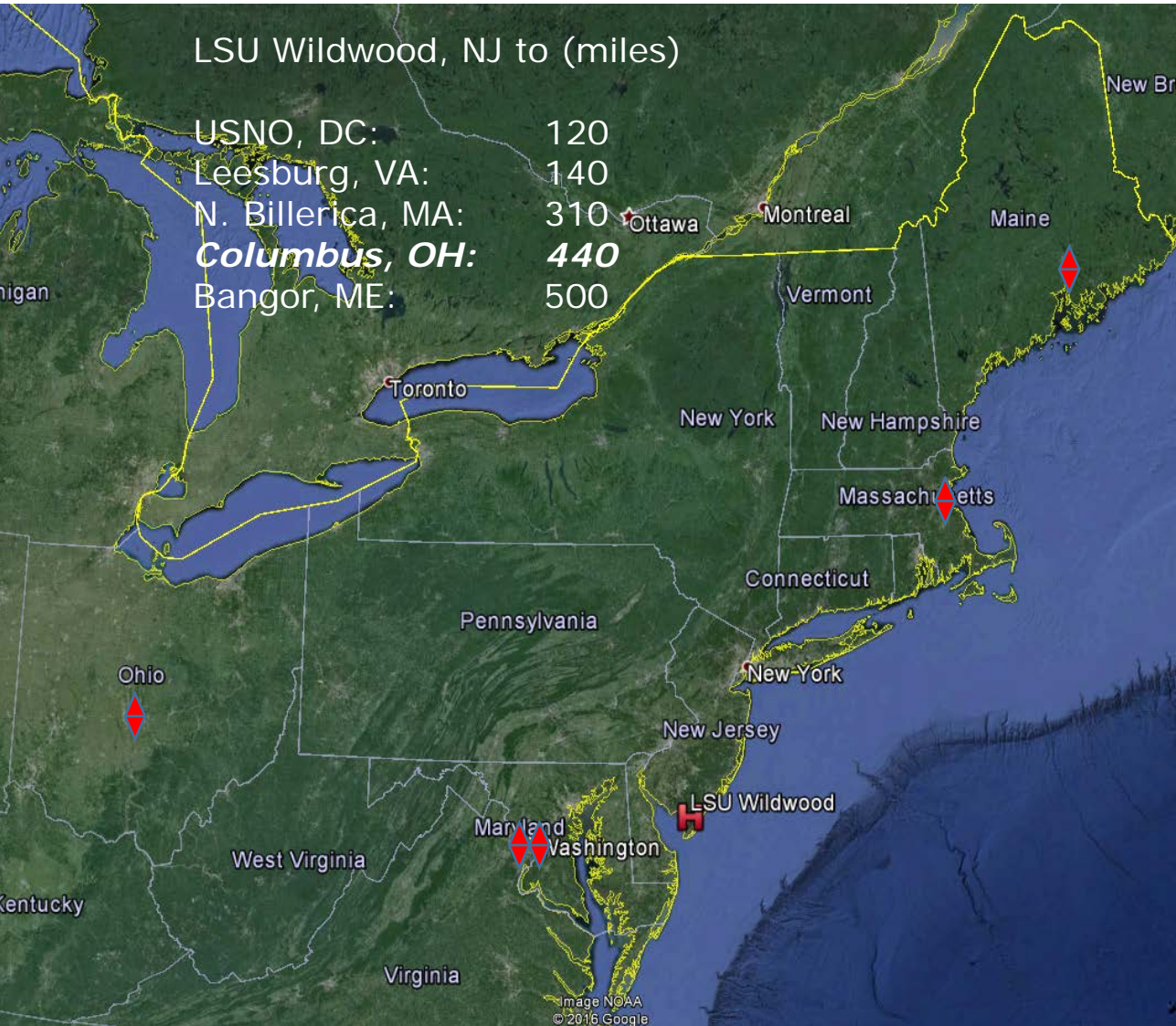
Bangor, ME: 500

- eLoran transmitter at Wildwood, NJ

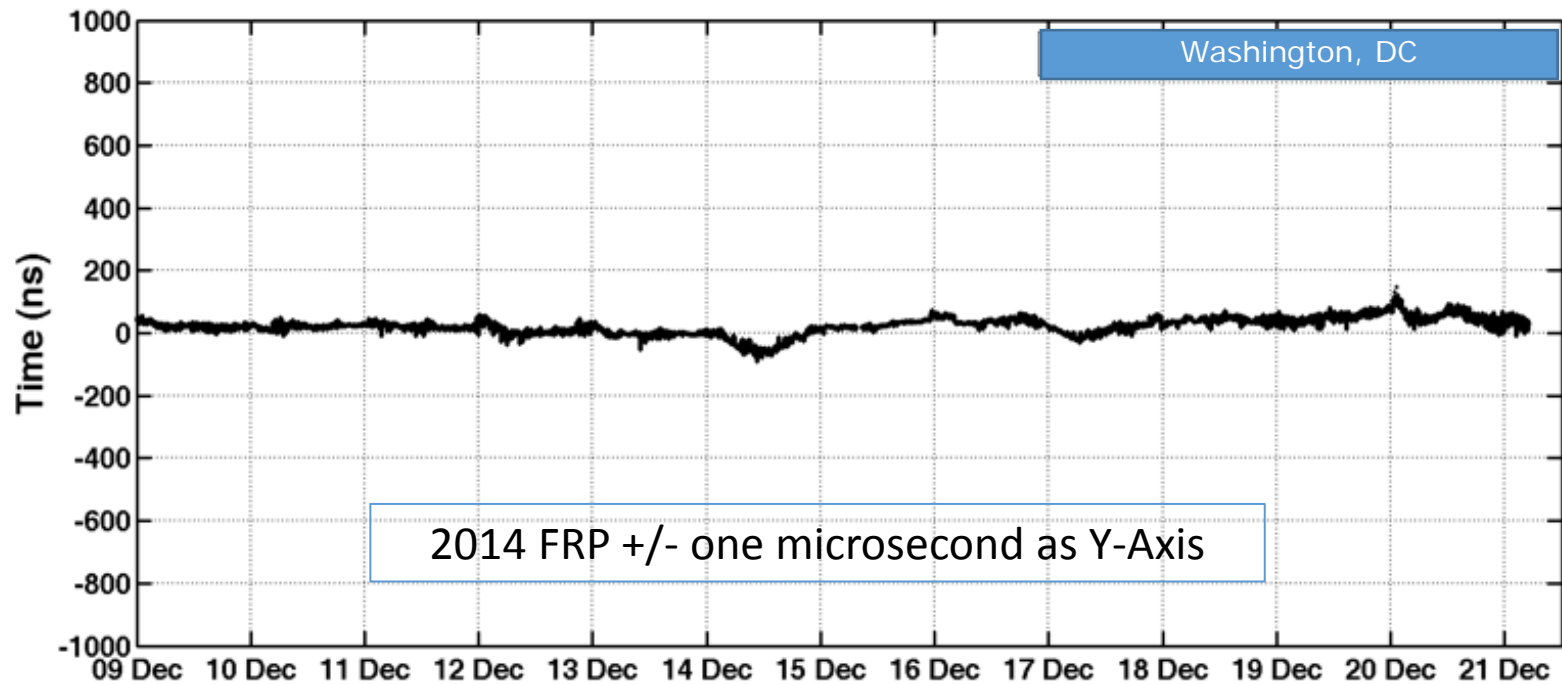
- Synchronized to UTC via Two Way Satellite Time Transfer (TWSTT) provided by US Naval Observatory
- 360KW of Effective Radiated Power
- Broadcasting dual rated as 8970 Master and Secondary
- Data sent via LDC only on Secondary rate at raw data rate of 56 bps and effective data rate of 21 bps

- Differential eLoran Reference sites at:

- North Billerica, MA
- Leesburg, VA

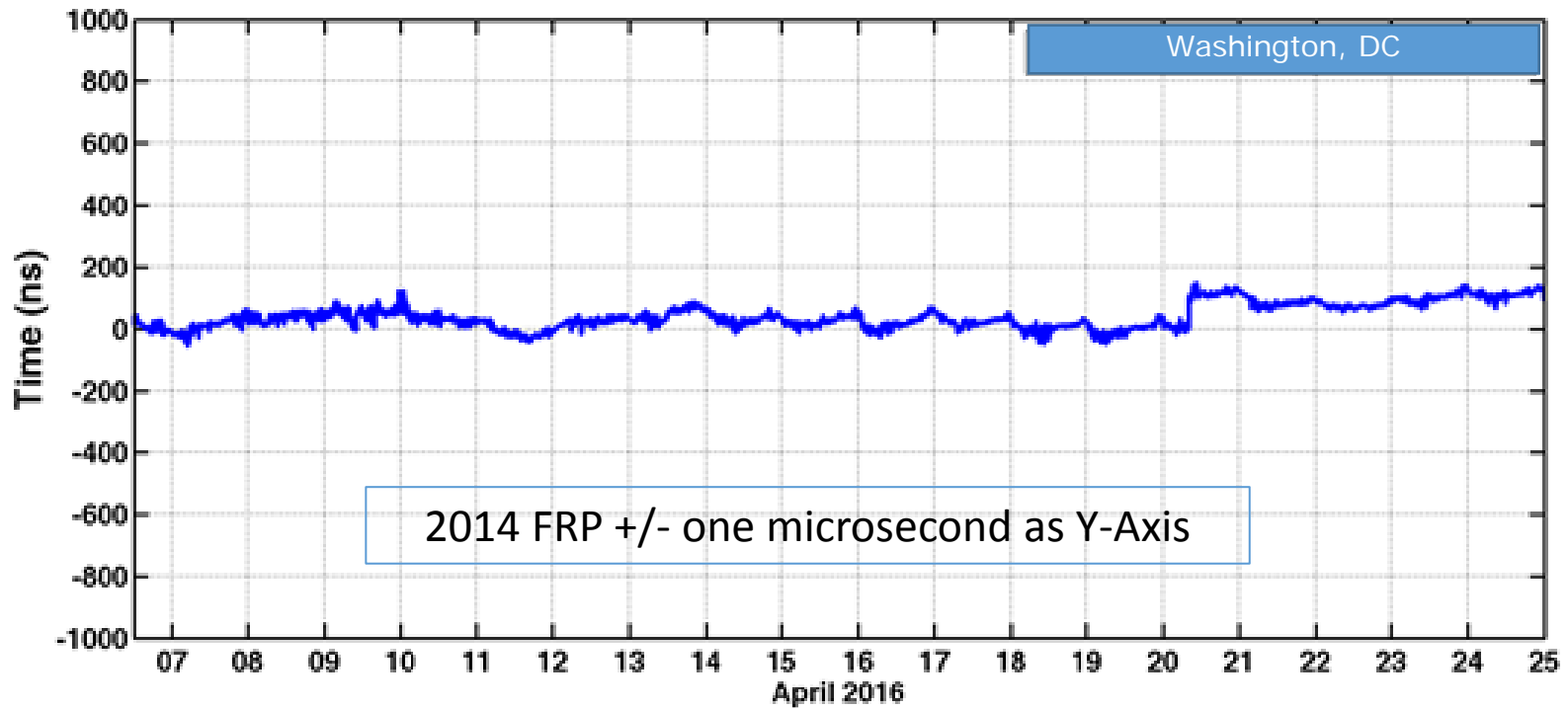


Wildwood, NJ to Washington, DC (USNO) User Receiver



December 2015
Distance to XMTR: 120 miles
Mean: 22.9 ns
STD: 26.1 ns
Max: 147.0 ns
Min: -90.0 ns

Wildwood, NJ to Washington, DC (USNO) User Receiver



April 2016

Distance to XMTR: 120 miles

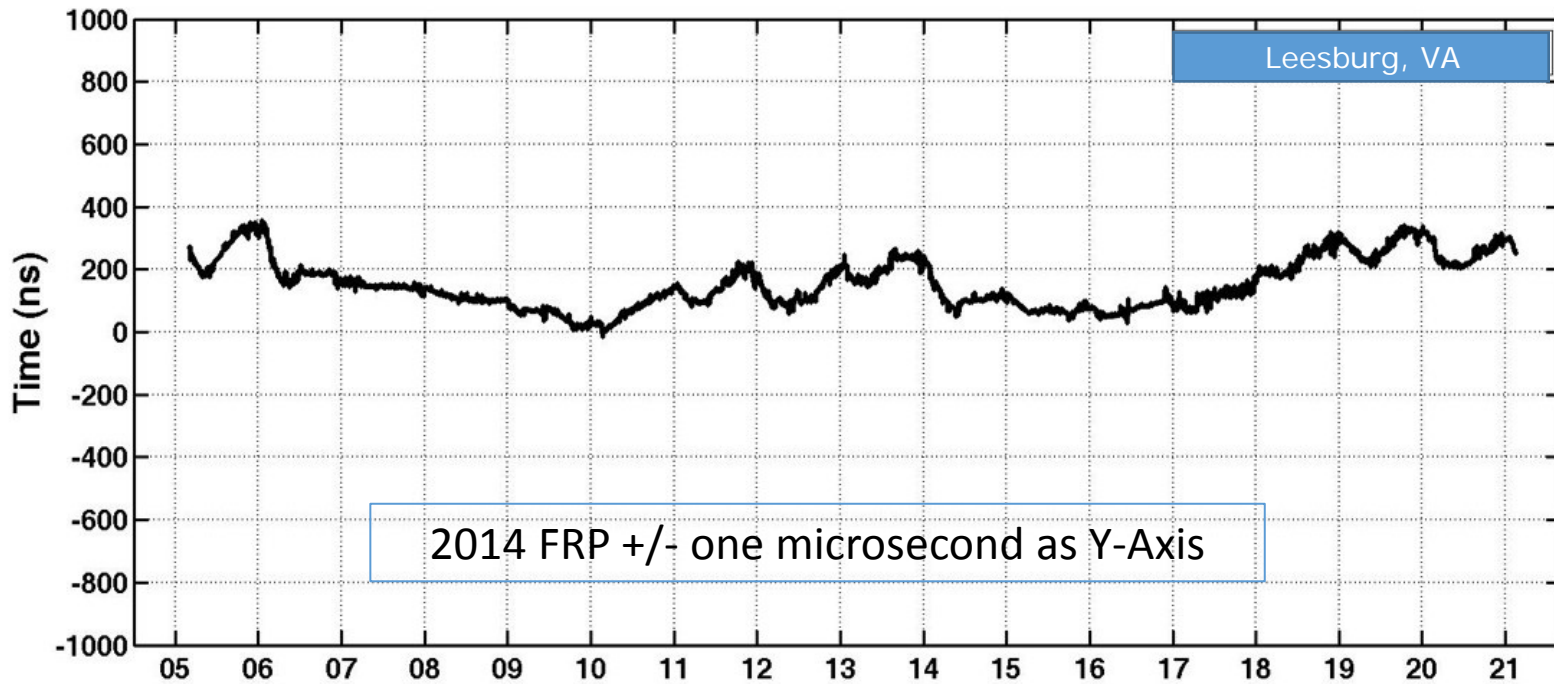
Mean: 41.3 ns

STD: 39.4 ns

Max: 147.0 ns

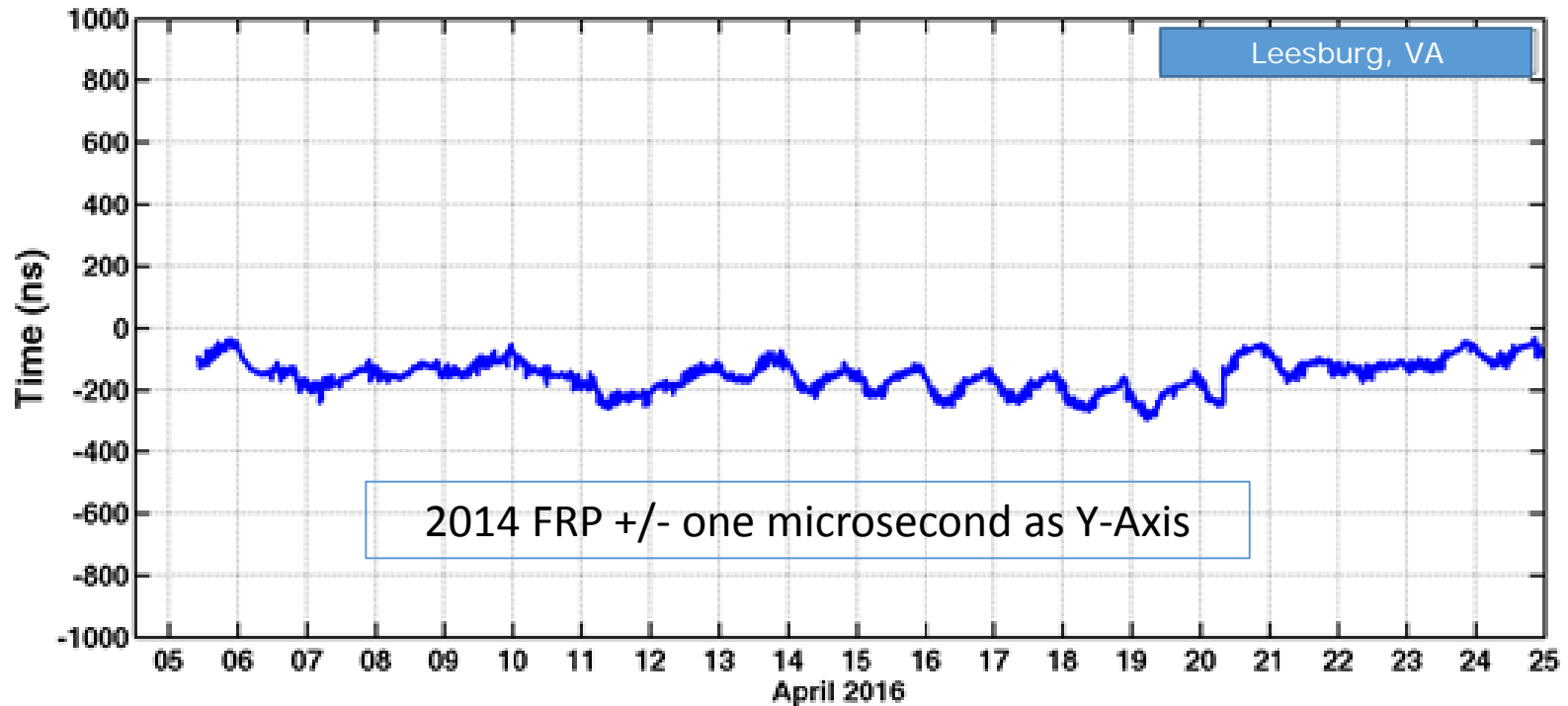
Min: -57.0 ns

Wildwood, NJ to Leesburg, VA User Receiver



January 2016
Distance to XMTR: 140 miles
Mean: 153.6 ns
STD: 79.9 ns
Max: 358.0 ns
Min: -16.0 ns

Wildwood, NJ to Leesburg, VA User Receiver



April 2016

Distance to XMTR: 140 miles

Mean: -153.0 ns

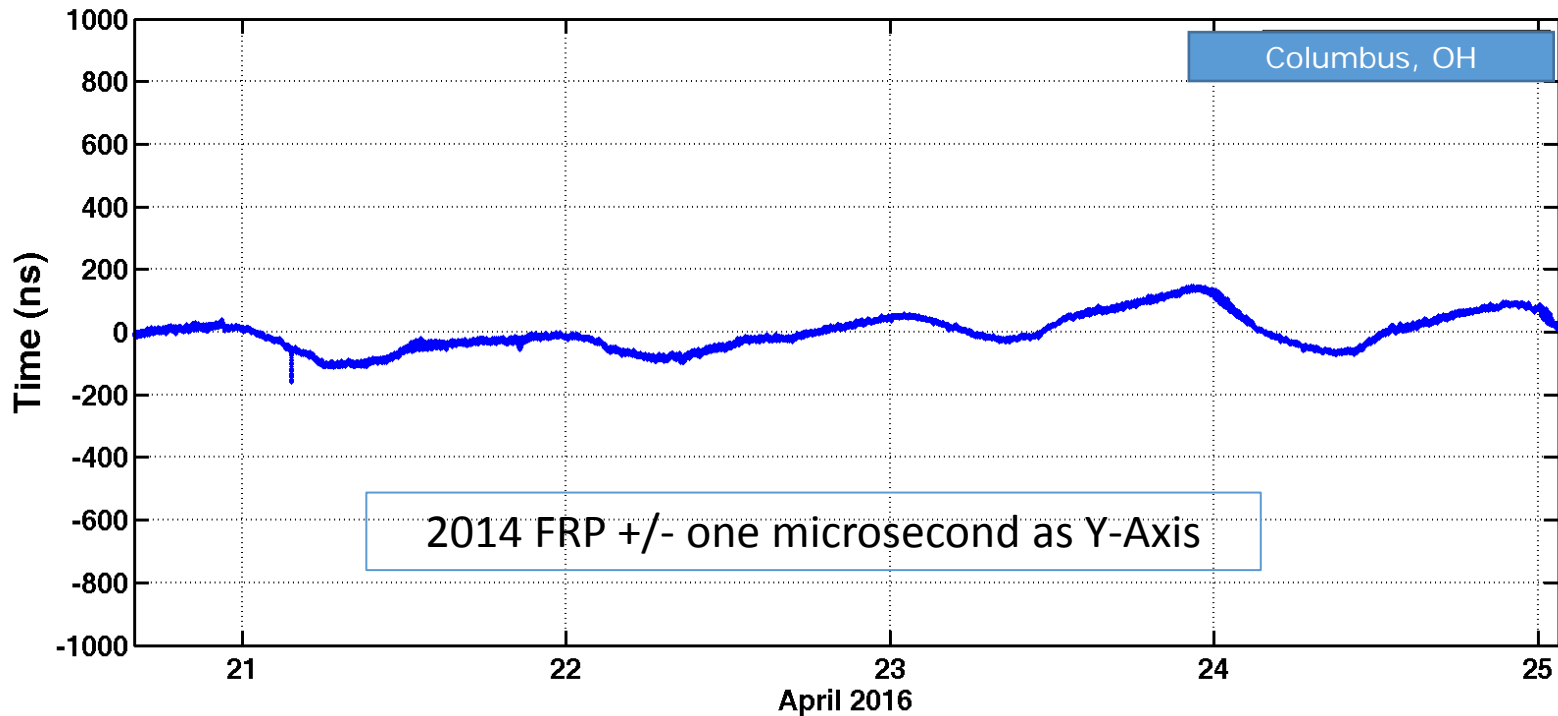
STD: 49.1 ns

Max: -31.0 ns

Min: -298.0 ns

New location, so no previous Columbus, OH data.

Wildwood, NJ to Columbus, OH User Receiver



April 2016

Distance to XMTR: 440 miles

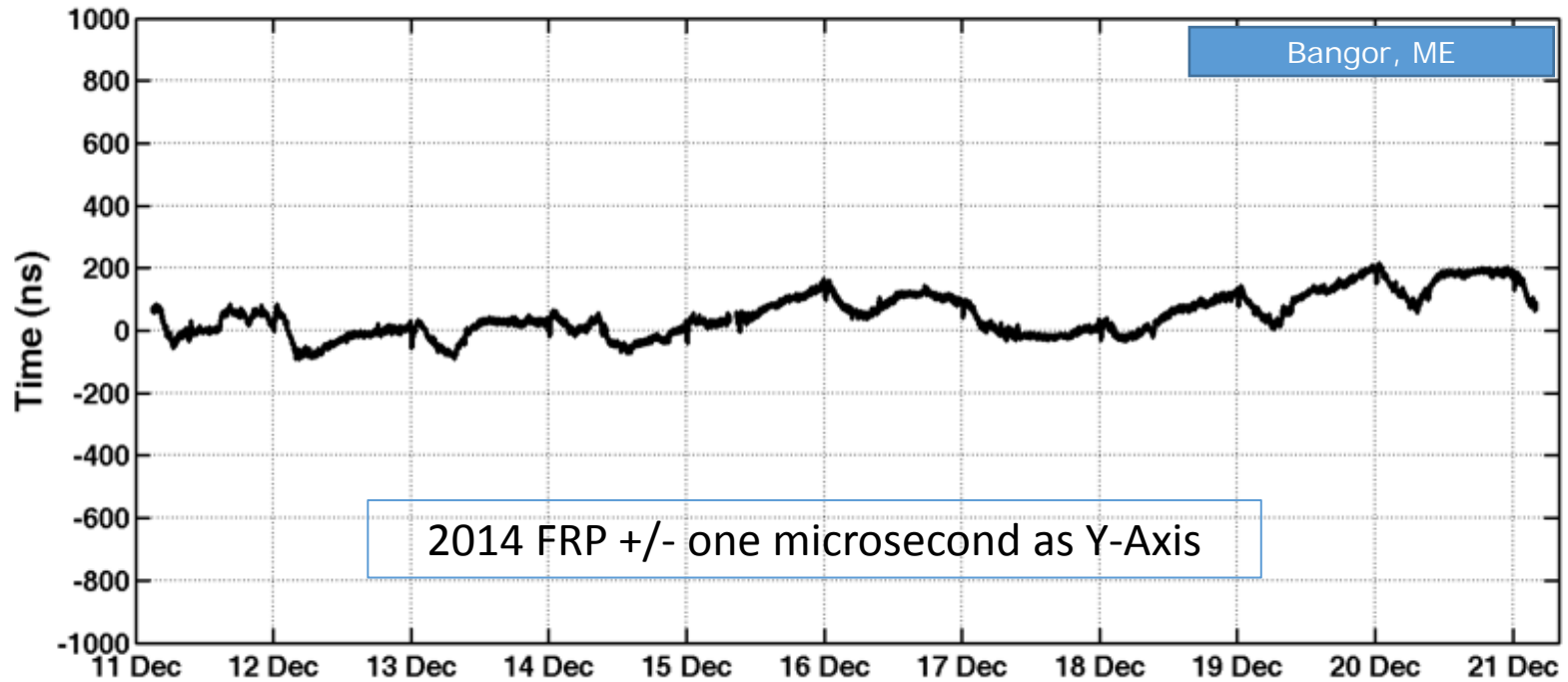
Mean: 170.4 ns

STD: 56.4 ns

Max: 148.6 ns

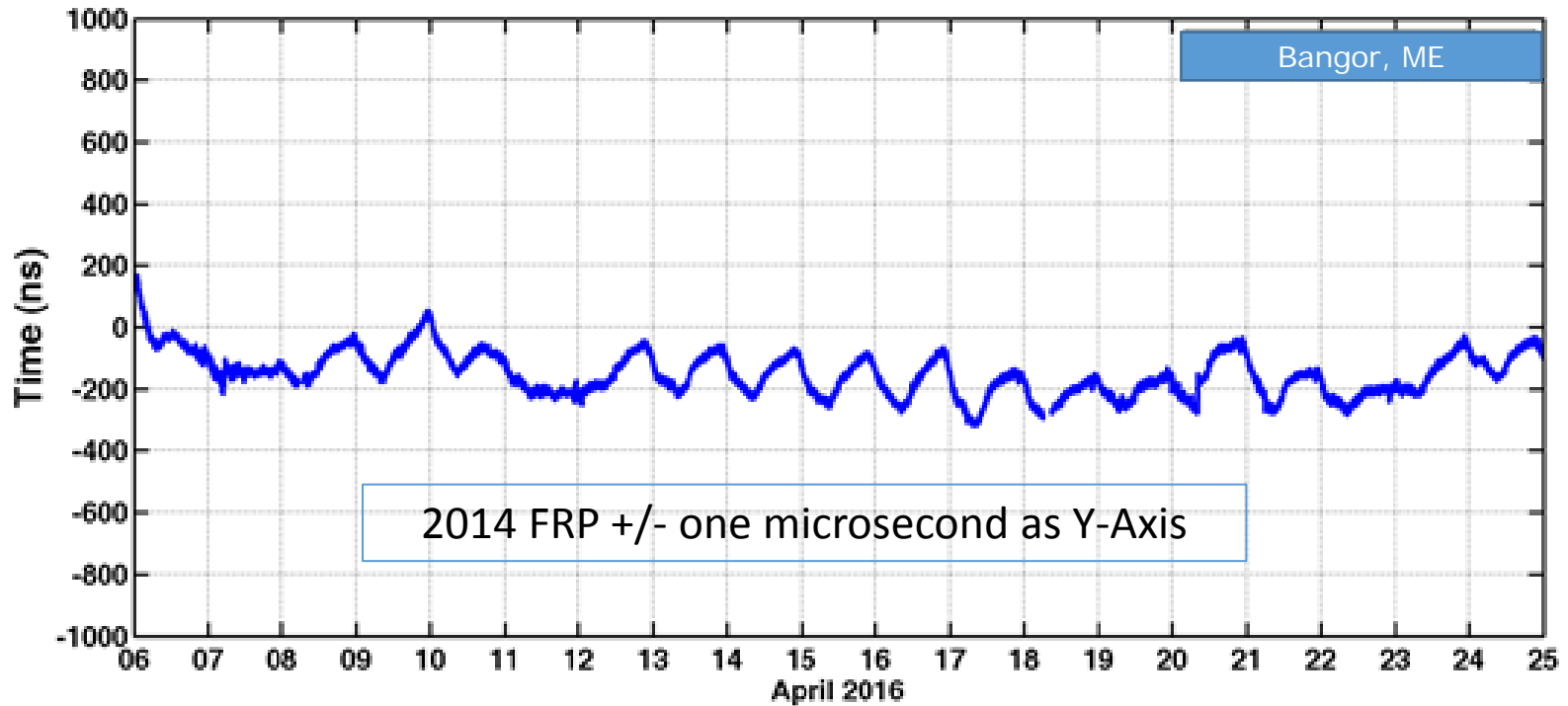
Min: -159.4 ns

Wildwood, NJ to Bangor, ME User Receiver



December 2015
Distance to XMTR: 500 miles
Mean: 49.7 ns
STD: 68.6 ns
Max: 216.0 ns
Min: -91.0 ns

Wildwood, NJ to Bangor, ME User Receiver



April 2016

Distance to XMTR: 500 miles

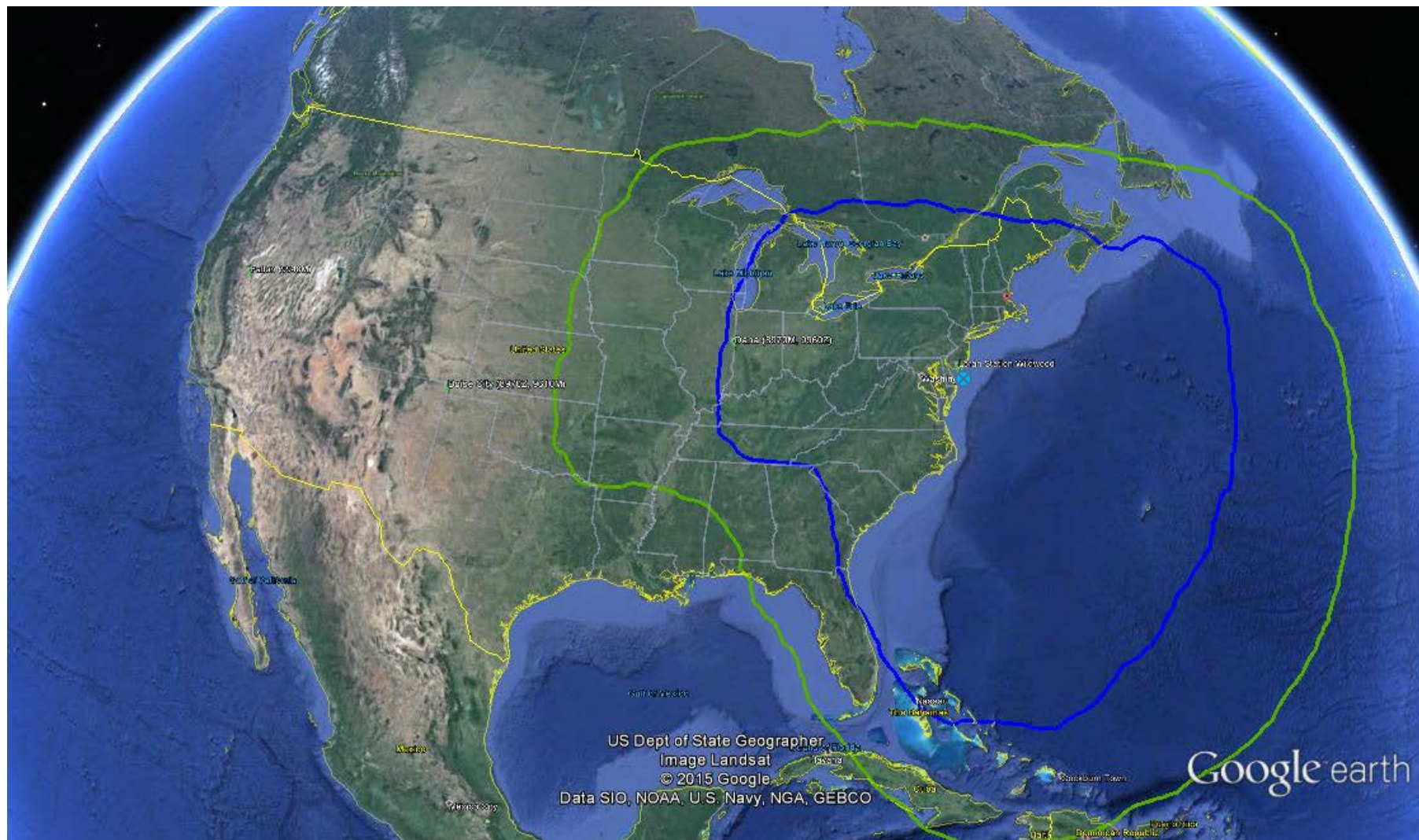
Mean: -149.1 ns

STD: 69.7 ns

Max: 171.0 ns

Min: -318.0 ns

Coverage From Former Wildwood, NJ Transmitting Site



2014 FRP Coverage Area. — 360 KW transmissions. — 1 MW transmissions.

Take Aways

- ✓ eLoran **is** a stable, wide area source of PNT for redundancy and resiliency in critical infrastructure and key resource sectors.
- ✓ It works in many locations where GPS is not available. It works when GPS may be untrustworthy.
- ✓ **Without** differential corrections, eLoran is capable of meeting 2014 FRP timing user requirements of +/- 1 microsecond over very wide areas.
- ✓ **With** the application of differential corrections, eLoran is capable of meeting the needs of higher accuracy timing users of +/- 100 nanoseconds over a local area.
- ✓ With an initial four transmitting stations, eLoran can provide resilient and complementary timing, frequency, and data over the Lower 48 United States.
- ✓ With additional transmitting stations, eLoran can provide additional resilience and complementary positioning over the Lower 48 United States.
- ✓ eLoran is efficient, economical, and can be provided expeditiously.

Contact Us for Collaborative Efforts!

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