

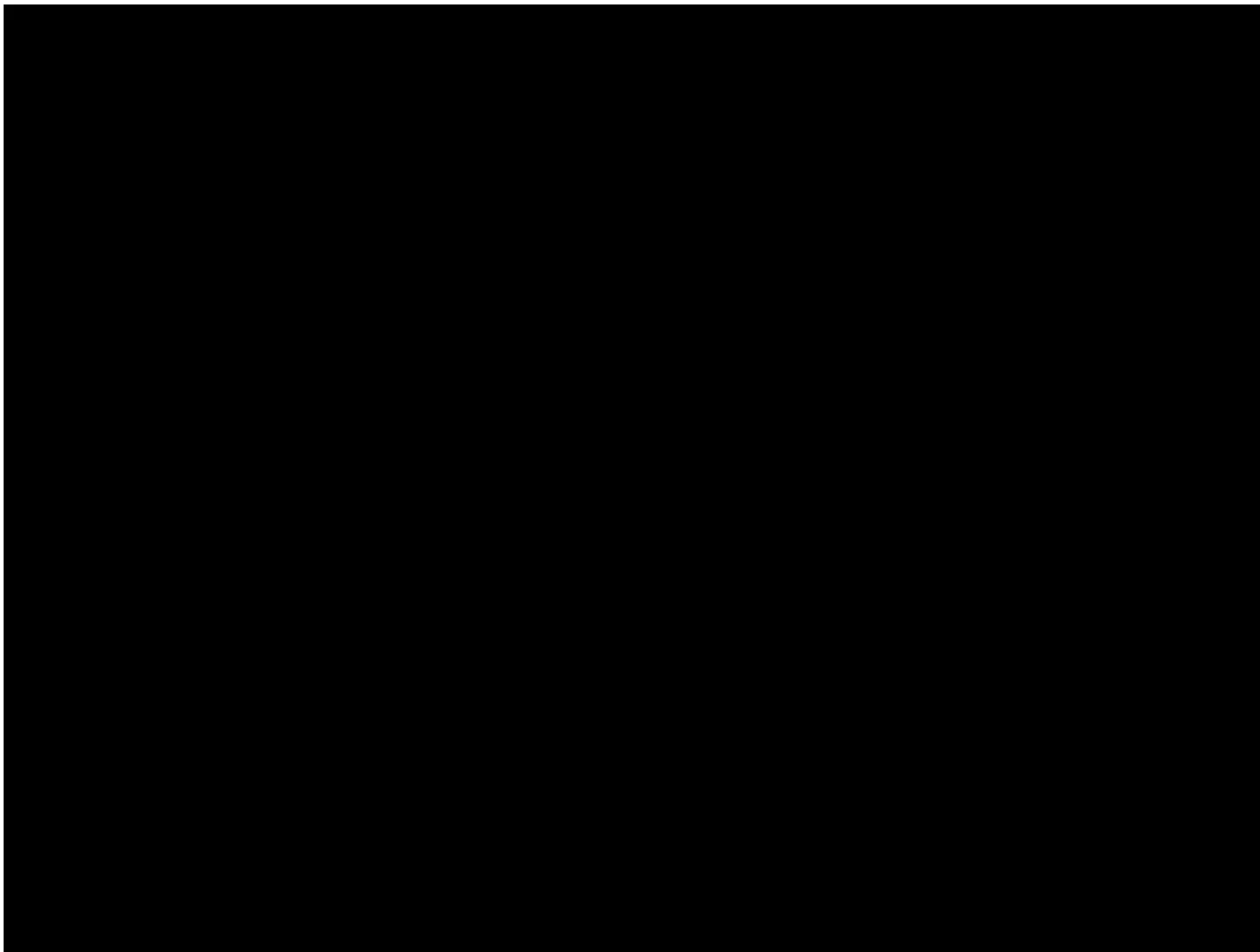


USNO eLoran Testing

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USNO
202 762-1451



What is Loran (Long Range Navigation)?



[Source: Smithsonian: Time and Navigation. History of the LORAN System. 2012]

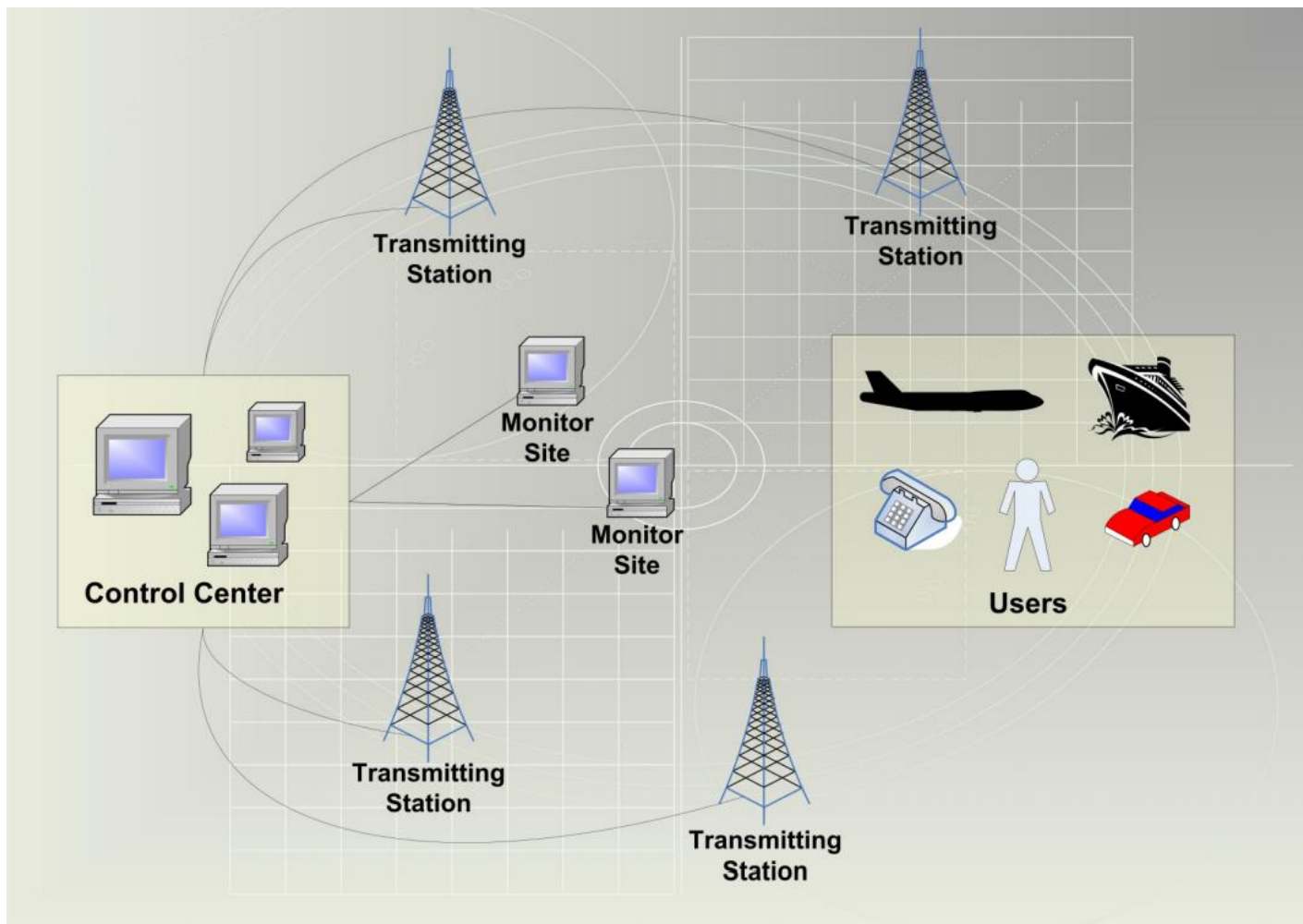


What is eLoran?

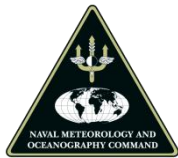


- **eLoran (Enhanced Long Range Navigation) is a ground based radio navigation system**
 - **Not a replacement of GPS but a complement/backup**
 - **Derived from the old Loran-C systems**
 - **With the addition of a data channel on the transmitted signal**
 - **In USA, old transmission stations from Loran-C systems are reused for eLoran testing**
 - **Relies on transmission stations and the difference between the signals from two stations**
 - **Grouped into chains – a single master station and secondary stations**
 - **Master station transmits first, followed by successive transmissions from each of the secondary stations of the chain**
 - **Master & secondary transmission sequence is repeated periodically**
 - **Each station emits precisely timed and shaped radio pulses centered at 100kHz**
 - **8 pulses spaced 1000 microseconds apart**

What is eLoran?



[Source: International Loran Association. Enhanced Loran (eLoran) Definition Document. V1.0, 2007]

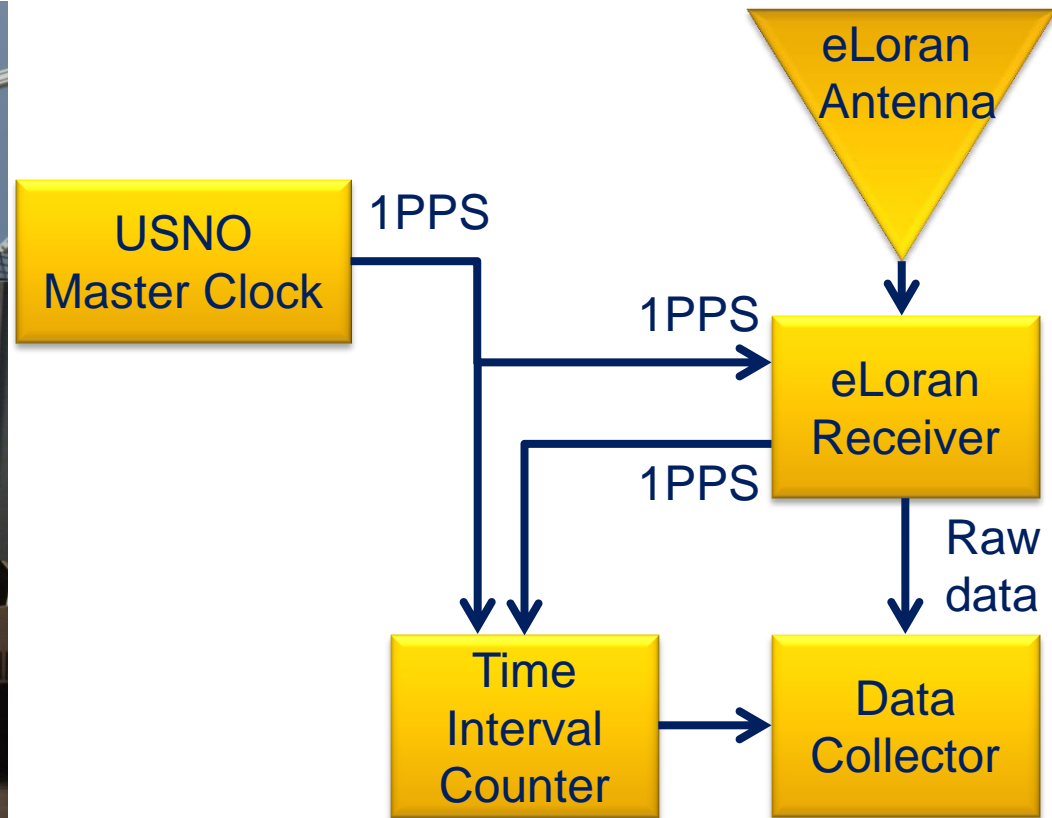


eLoran Testing



- **Cooperative Research and Development Agreement (CRADA)**
 - **UrsaNav, Exelis, the Department of Homeland Security's Science and Technology Directorate (DHS S), and the U.S. Coast Guard**
 - **Testing and demonstration at former LORAN-C sites**
- **2 tests at USNO**
 - **Coordinated with UrsaNav**
 - **July 20-22, 2015**
 - **Presentation as part of D.C. Section ION meeting held at USNO**
 - **August 25-28, 2015**
 - **Wildwood 08/25 0900(EDT) through 08/28 1800(EDT)**
 - **Broadcasting as 8970 Master and Secondary**
 - **What is the achievable time transfer from UTC value?**
- **USNO has a TWSTT setup in Wildwood, NJ to support these tests**

eLoran Testing at USNO

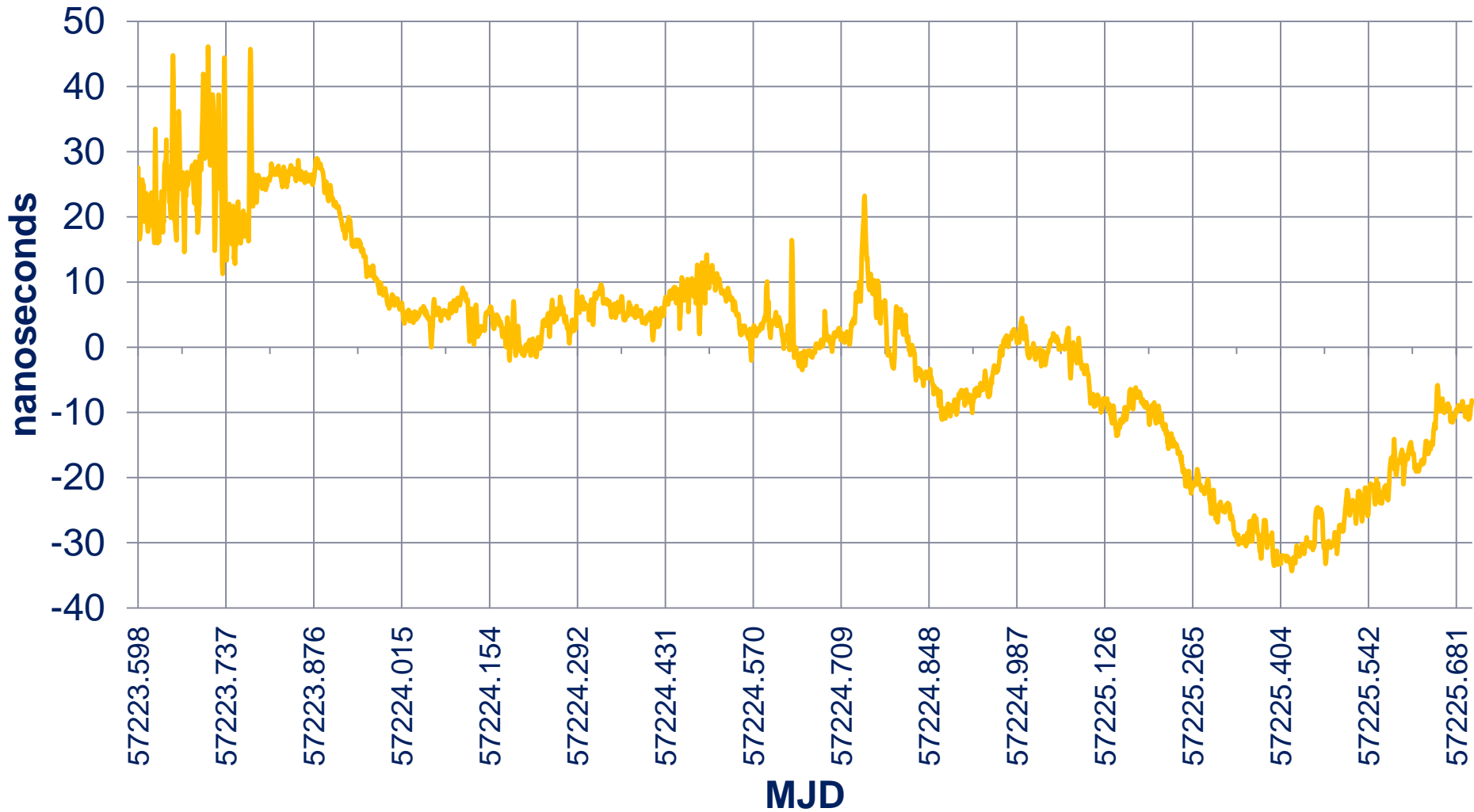




eLoran at USNO July 20-22, 2015



1pps difference USNO MC vs eLoran

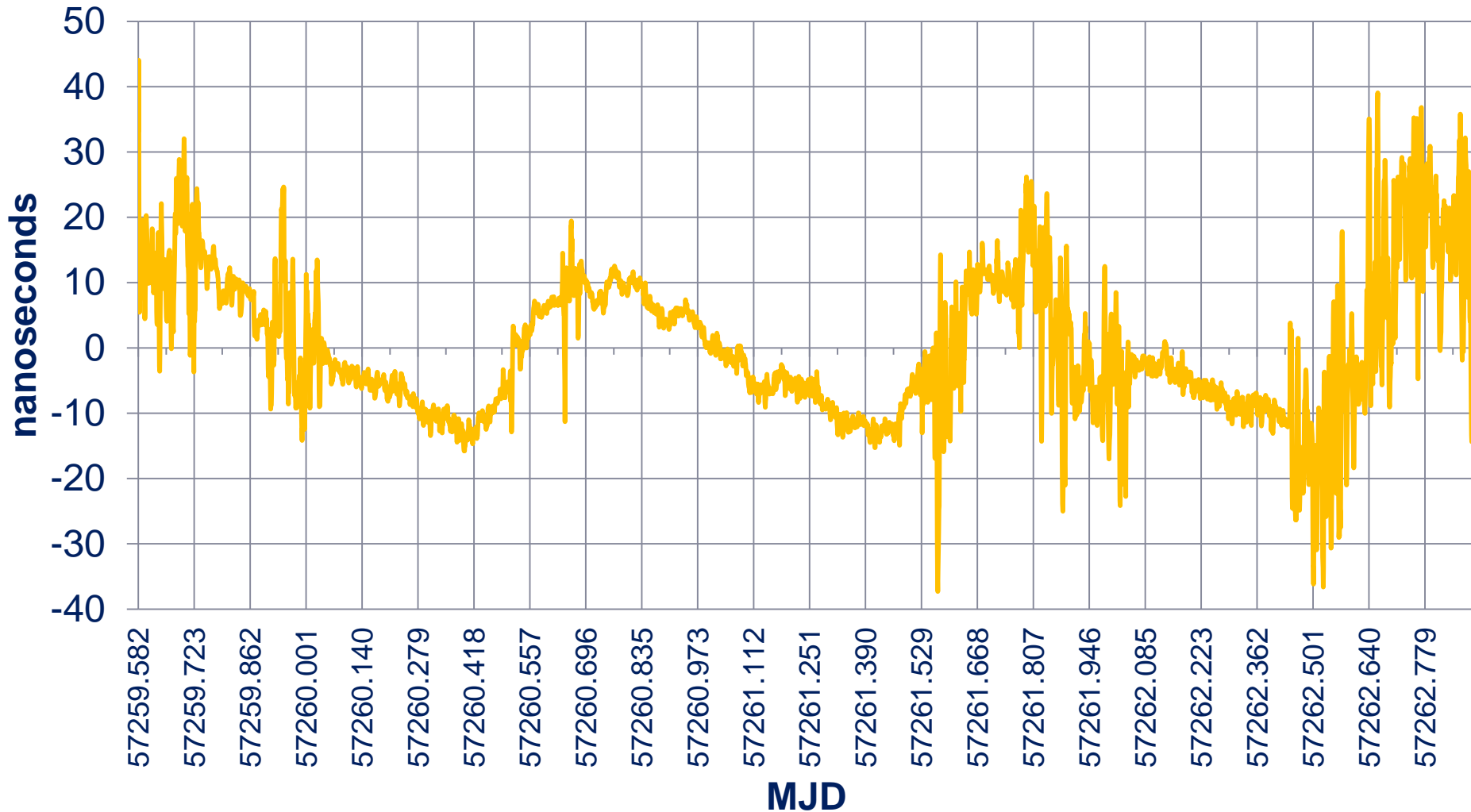


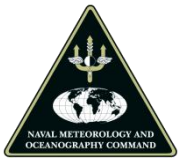


eLoran at USNO Aug 25-28, 2015

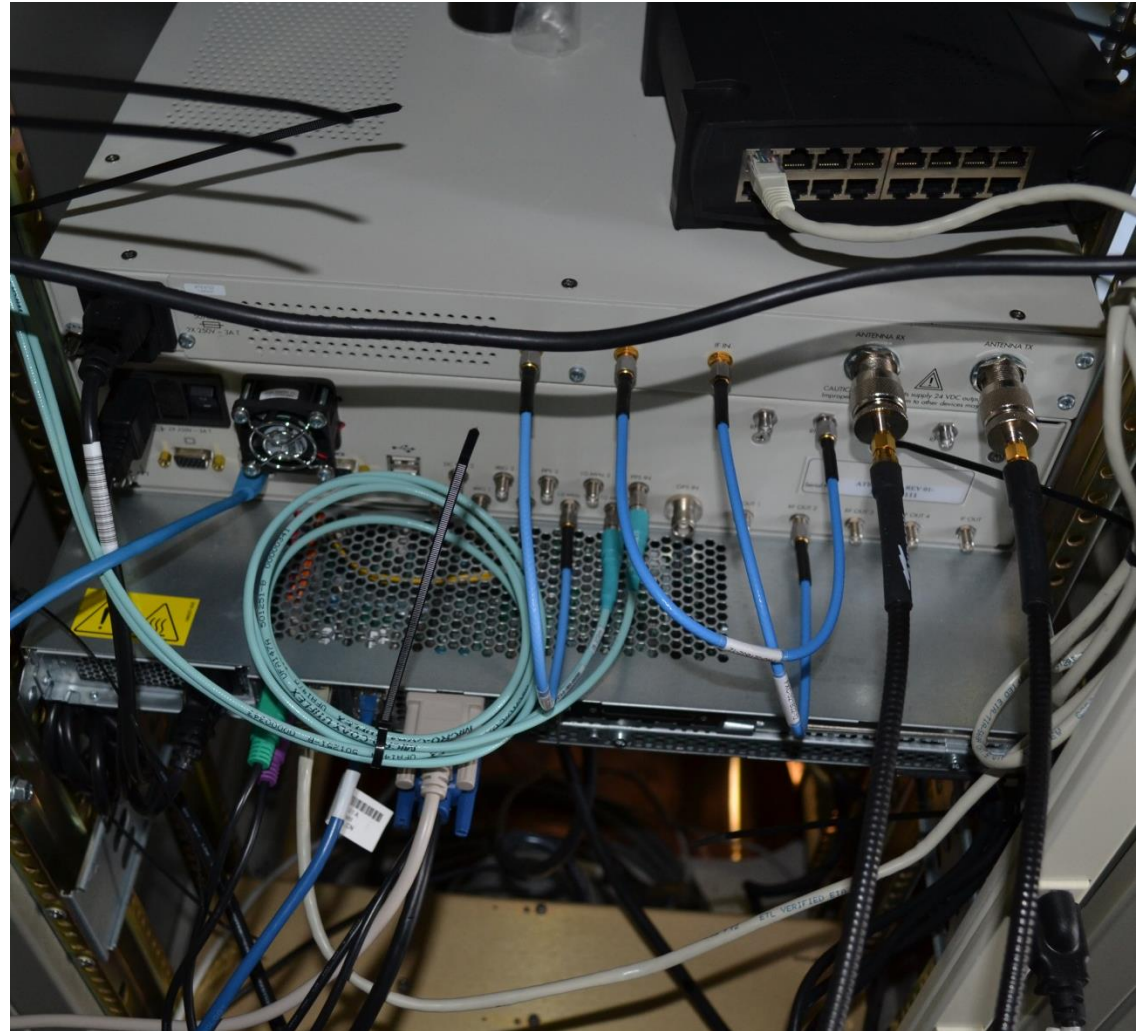


1pps difference USNO MC vs eLoran





eLoran, TWSTT at Wildwood, NJ

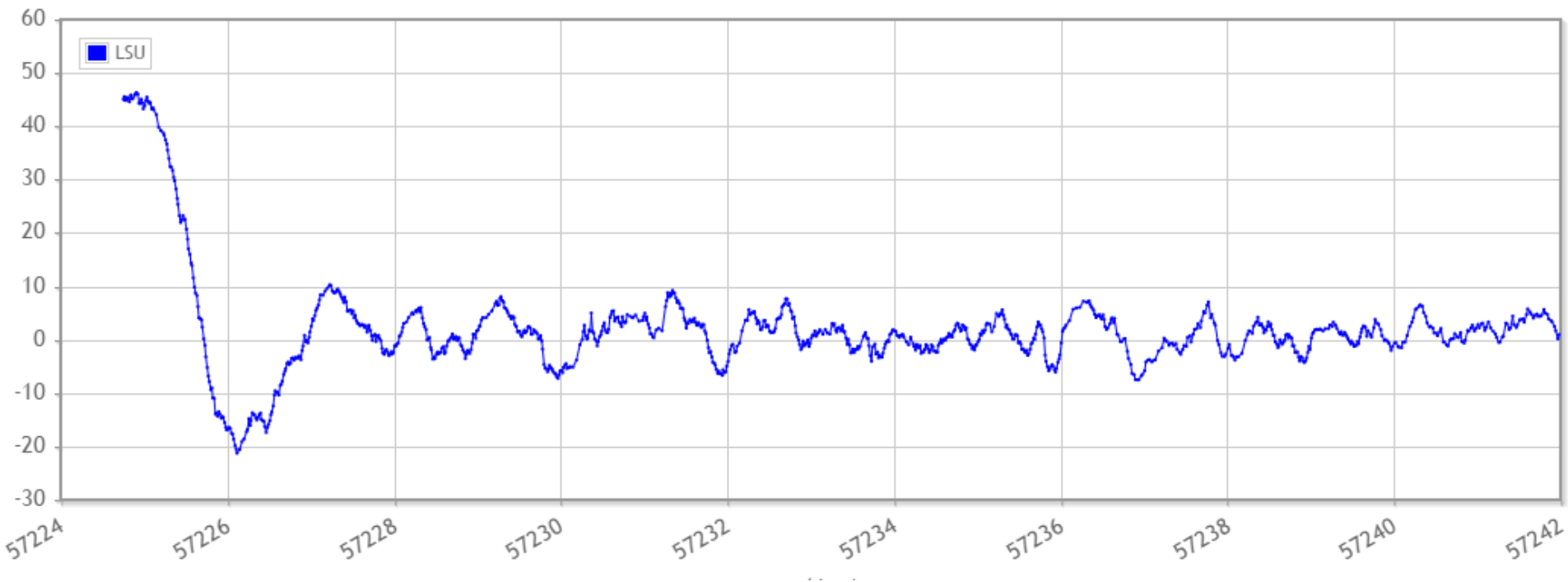


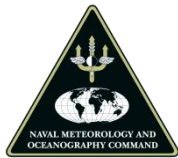


eLoran, TWSTT at Wildwood, NJ



UTC(USNO) – Loran Support Unit(LSU) Cesium July 21 – Aug 08, 2015





eLoran Testing at USNO



- **Results to date indicate better than 50ns from UTC is achievable**
 - *Even with equipment that has not been maintained for 2-4 years*
 - *eLoran will work with previously installed Loran-C stations*
- **Further improvements can be achieved with application of different corrections transmitter steering towards UTC using TWSTT from USNO**
- **The quest for a system to complement GPS continues...**