

Navy PTTI Report

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Abstract

The U.S. Naval Observatory is charged under Department of Defense (DoD) instruction 5000.2 with the responsibility for maintaining the timing standard in support of all DoD operations. Accomplishment of this task involves generating a time reference and then disseminating the Precise Time and Time Interval (PTTI) information to users within, as well as outside, DoD. A major effort has been undertaken by Navy scientists in recent years to upgrade and improve these services. Understanding the characteristics of atomic clocks, such as hydrogen masers, cesium beam frequency standards, and stored ion devices, is a prerequisite for modelling their performance and developing the most stable time reference possible. Algorithms for optimum clock ensembling and precision clock steering must be developed to ensure the stability of the time reference. Implementing new methods for time transfer, such as two-way satellite time transfer and laser ranging, will lead to improved accuracies to less than one nanosecond. In addition, the determination of astronomical time based on the Earth's rotation and definition of parameters for the position of the poles, enable the correction of the dynamical reference frame of Earth-orbiting satellites to an inertial reference frame, which is needed to improve the precision of satellite orbits. Current and planned initiatives in PTTI within the Navy, such as those listed above, are described.

It is a great pleasure to address you this morning. I'm Jim Burton. I'm the GPS Action Officer for N6 and I am the U.S. representative to a NATO subcommittee on navigation. Ron Beard is also a member of this NATO subgroup. Today, I will talk very briefly about Navy-funded initiatives concerning work in PTTI (Figure 1).

There are three major achievements which I will address today:

- a) the GPS monitor station upgrade;
- b) the technology transfer of the modem that NRL developed; and
- c) the USNO Time Service Substation being rebuilt in Florida.

First, the GPS monitor station upgrades (Figure 2). When the upgrades are completed, each monitor station will be an ensemble of three cesium clocks, one of which will be a standard that's connected to the USNO through a two-way time transfer. As we collect the data from this ensemble and compare it to the existing operations, it will enable us to better model the clock rate errors and separate the clock and ephemeris errors a little bit better than is being done right now. This is all part of Navy initiatives to improve the accuracy of GPS and the integrity as well.

With the third clock that we'll be installing in each of the monitor stations, we'll have the capability to work independently of the two clocks that are currently operating within the monitor station. But even if it's operating independently, it will enable us to gather the data and do the diagnostics to better model the system for accuracy improvements in the future.

Secondly, NRL developed a pseudorandom noise time transfer modem (Figure 3) for the basic requirement of providing a communications capability besides just passing time pulses back and forth through the modem. It also gets a U.S. vendor into the market, so we are not relying on vendors from Germany; now we have Allen Osborne and Associates as the American vendor.

Finally, concerning the restoration of the USNO Time Service Substation (Figure 4) which was destroyed in Hurricane Andrew, a couple of years back, it is basically restored. It is going through the final stages of testing before it's back on line as a fully certified backup.

Since I'm here to replace Dave Markham, who was not supposed to be here, I will be happy to answer any questions – or at least point them in the right direction.

DAVE MARKHAM: Let me elaborate on Cdr. Burton's last comment. Those of you who didn't hear the story yet, I was supposed to be in Bahrain today. But unfortunately through a "snafu," as we say in the Navy, my orders and tickets were withdrawn and I'm here instead. He was gracious enough to stand in for me and give the presentation that I was supposed to give. So I thank him and I appreciate your support, Jim.



Major Achievements

- ★ GPS Monitor Station Upgrade funded
- ★ Technology Transfer of NRL developed modem to Allen Osborne Assoc., Inc.
- ★ NOTSS restored to back-up status after Hurricane Andrew



GPS Monitor Station Upgrade

- ★ Ensemble of 3 Cesium Clocks
- ★ Independent Time Transfer
via TWSTT
- ★ Diagnostics



Technology Transfer of NRL Developed Modem

- ★ **NRL developed PRN Time Transfer Modem**
- ★ **Communications Capability**
- ★ **Transferred to Allen Osborne Associates, Inc..**



NOTSS Restoration

- ★ Buildings rebuilt
- ★ New Antenna under construction
- ★ Clock System being upgraded
- ★ Back-up Status being tested