

USNO Activities

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**CGSIC
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Overview

- USNO GPS Operations
- USNO Common-View GPS
- New TTR-12 GPS Receiver
- USNO Internet Services



USNO GPS Operations

- **Precise Positioning Service (PPS)**
- **Standard Positioning Service (SPS)**



USNO PPS Operations

- **GPS Time Synchronization to UTC(USNO)**

- USNO to provide GPS with a reliable and stable reference to UTC
- GPS Time corrections provided to GPS MCS 2 SOPS daily

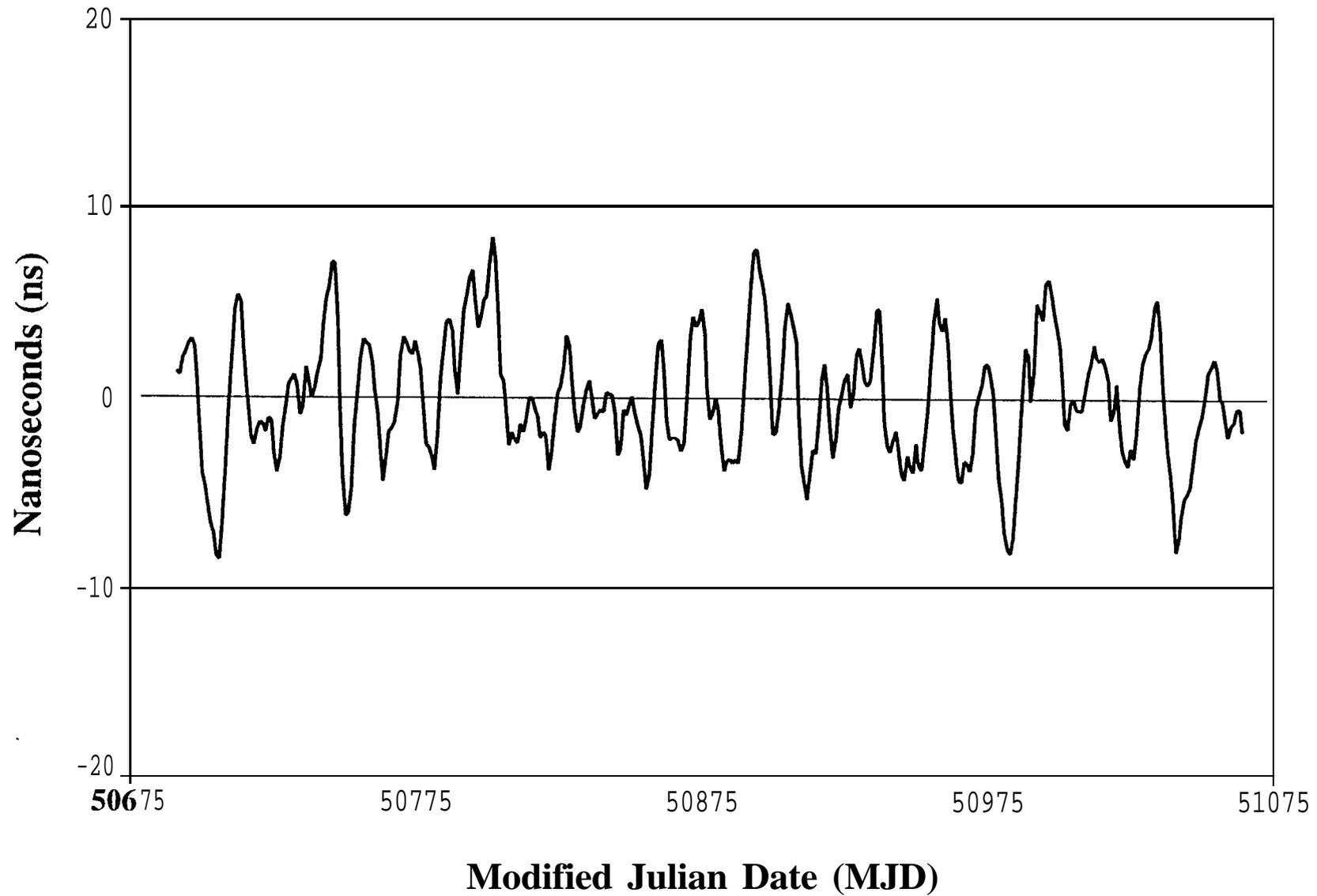
- **GPS Timing Specifications**

- GPS Time must be maintained to +/-1000 ns of UTC(USNO)
- UTC transmitted via GPS, UTC(GPS), must be within 28 ns of UTC(USNO)



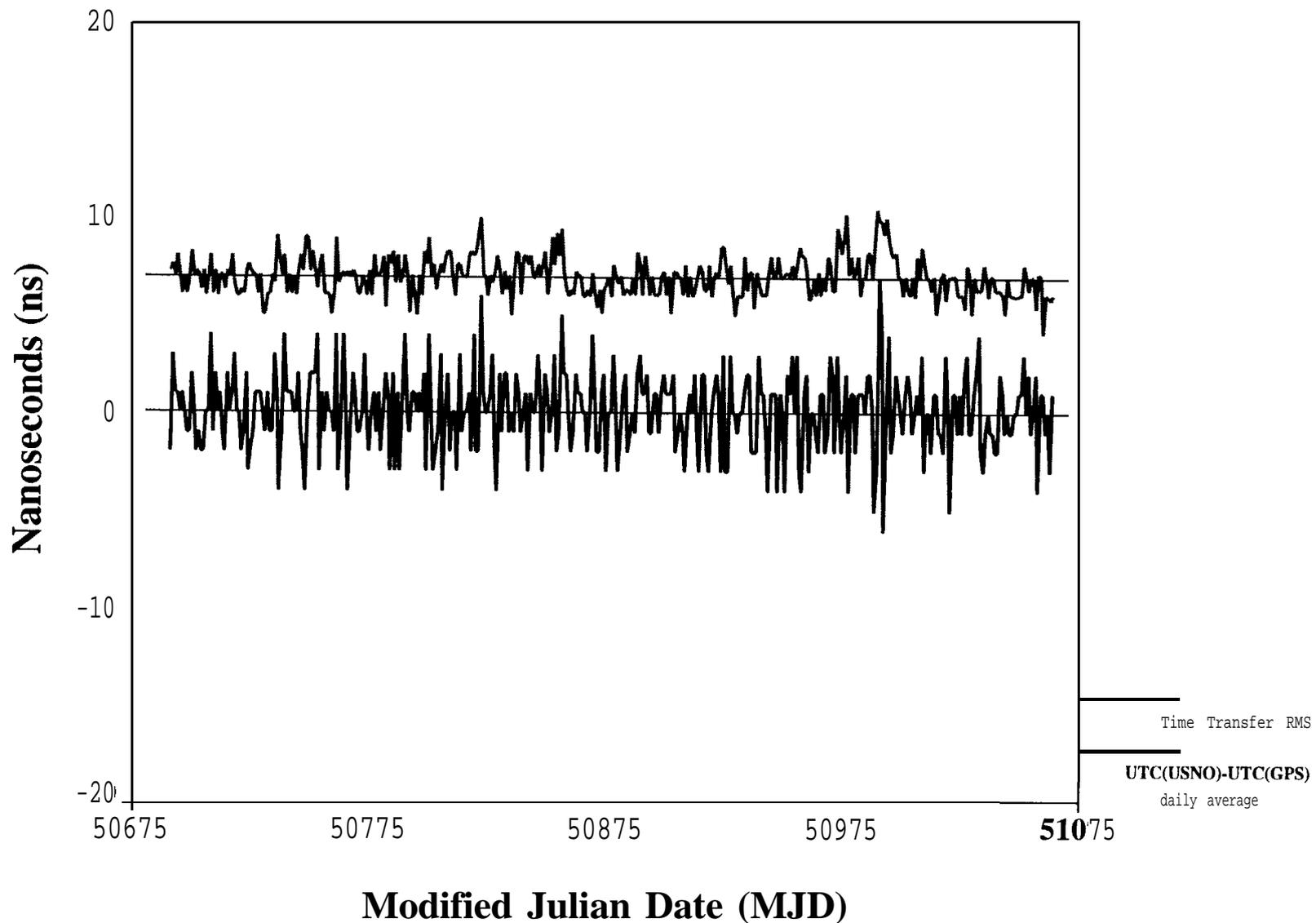
UTC(USNO) - GPS Time

01 SEP 97 - 08 SEP 98



UTC(USNO) - UTC(GPS)

01 SEP 97 - 08 SEP 98



USNO SPS Operations

• Common-View Time Transfer

- Incorporate USNO clocks into the computation of International Atomic Time (TAI)

• Time Steering of Remote Clocks

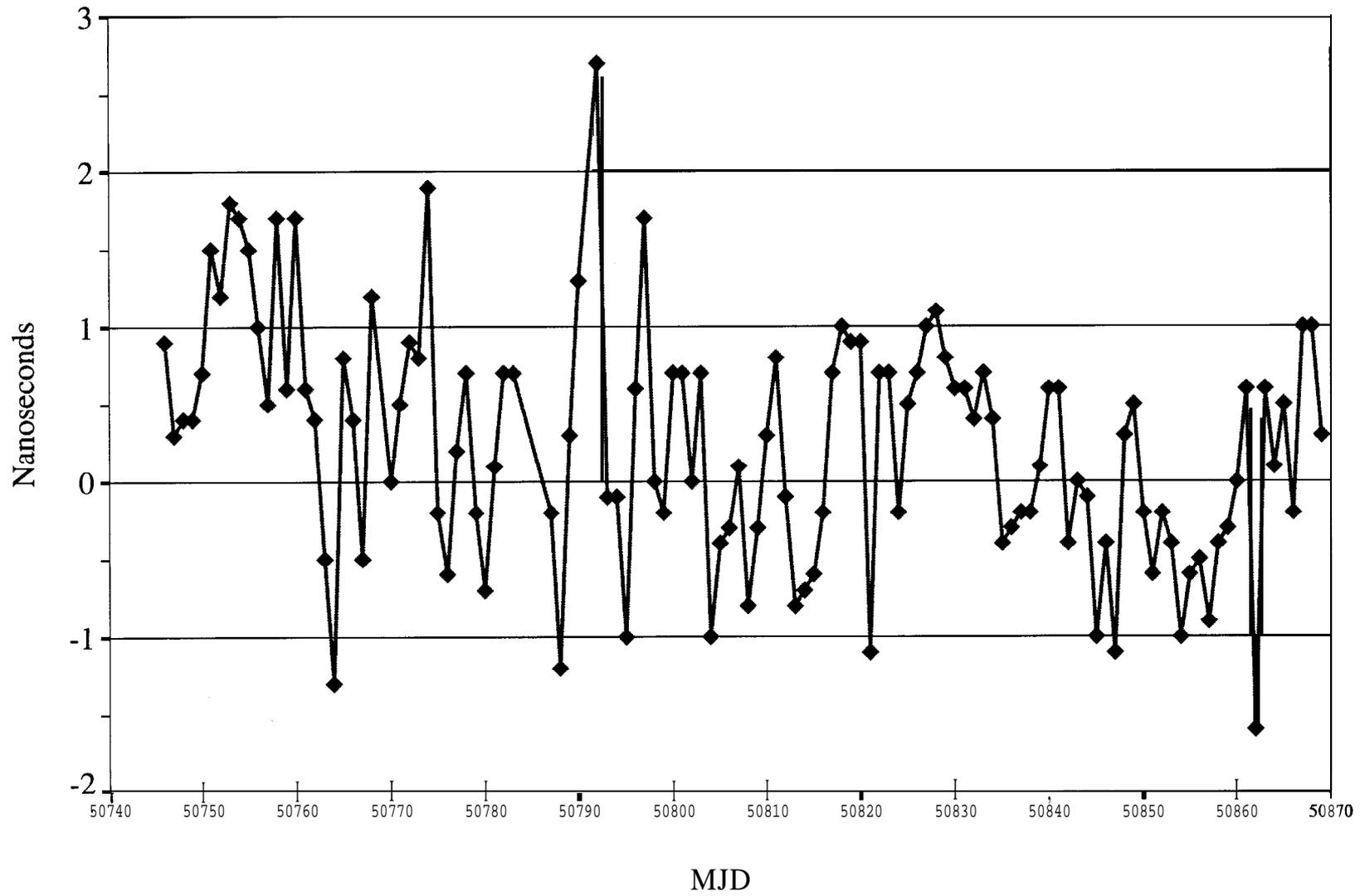
- U.S. Coast Guard Loran-C
- U.S. Air Force Precise Measurement Electronic Laboratories (PMEL)

• Future

- Participate in the International GLONASS Experiment (IGEX-98)
- Investigate GPS Carrier Phase Time Transfer



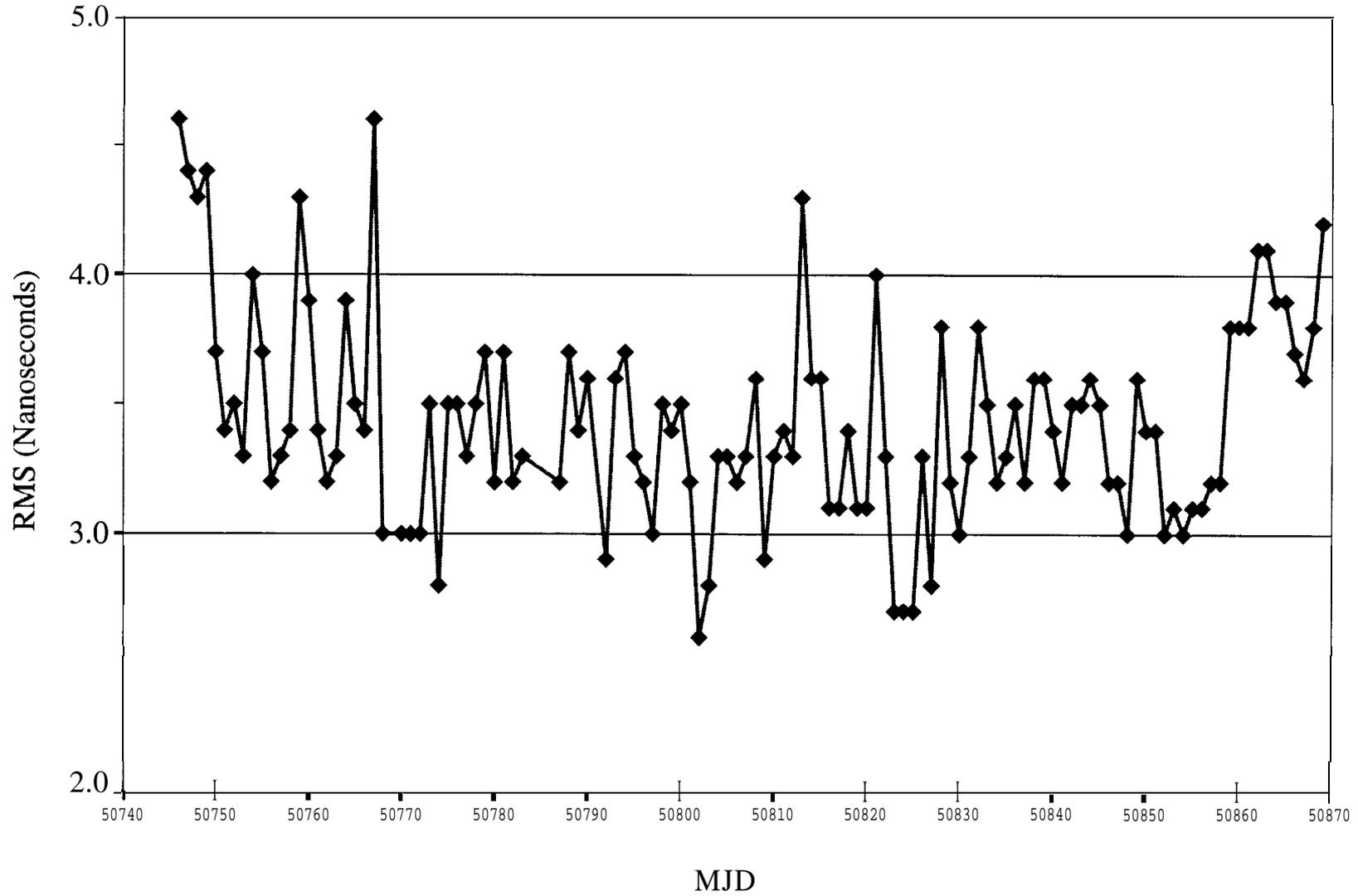
Multi-channel SPS Common View
USNO(MC2) - USNO(AMC(MC1))



USN01998

Multi-channel SPS Common-View

Daily RMS



Common-View Using Different Receiver Types

Average Daily RMS for Co-located Receiver Pairs

	AOA 8-channel TTR4P	AOA 1-channel TTR6	STel 1-channel 502
AOA 8-channel TTR4P	2 ns	6-7 ns	7 ns
AOA 1-channel TTR6	6-7 ns	2 ns	3-4 ns
STel 1-channel 502	7 ns	3-4 ns	-

TTR-12 Architecture

- Based on the TurboRouge 12-Channel and MSRE Receiver
- Modified for Time Transfer
- Improved External Time Reference Locking Circuit
- Improved 1PPS Comparisons



TTR-12 Operation

- Tracks up to 12 Satellites Dual Frequency Continuous
- Corrects for SAAS when keyed
- Code and Carrier Phase data Reported
- 100 Picosecond Time Comparison Precision



TTR-12 Applications

- GPS Time Monitoring & UTC Correction
- Common-View GPS Time Transfer with the USNO AMC
- Carrier Phase Time Transfer with the USNO AMC



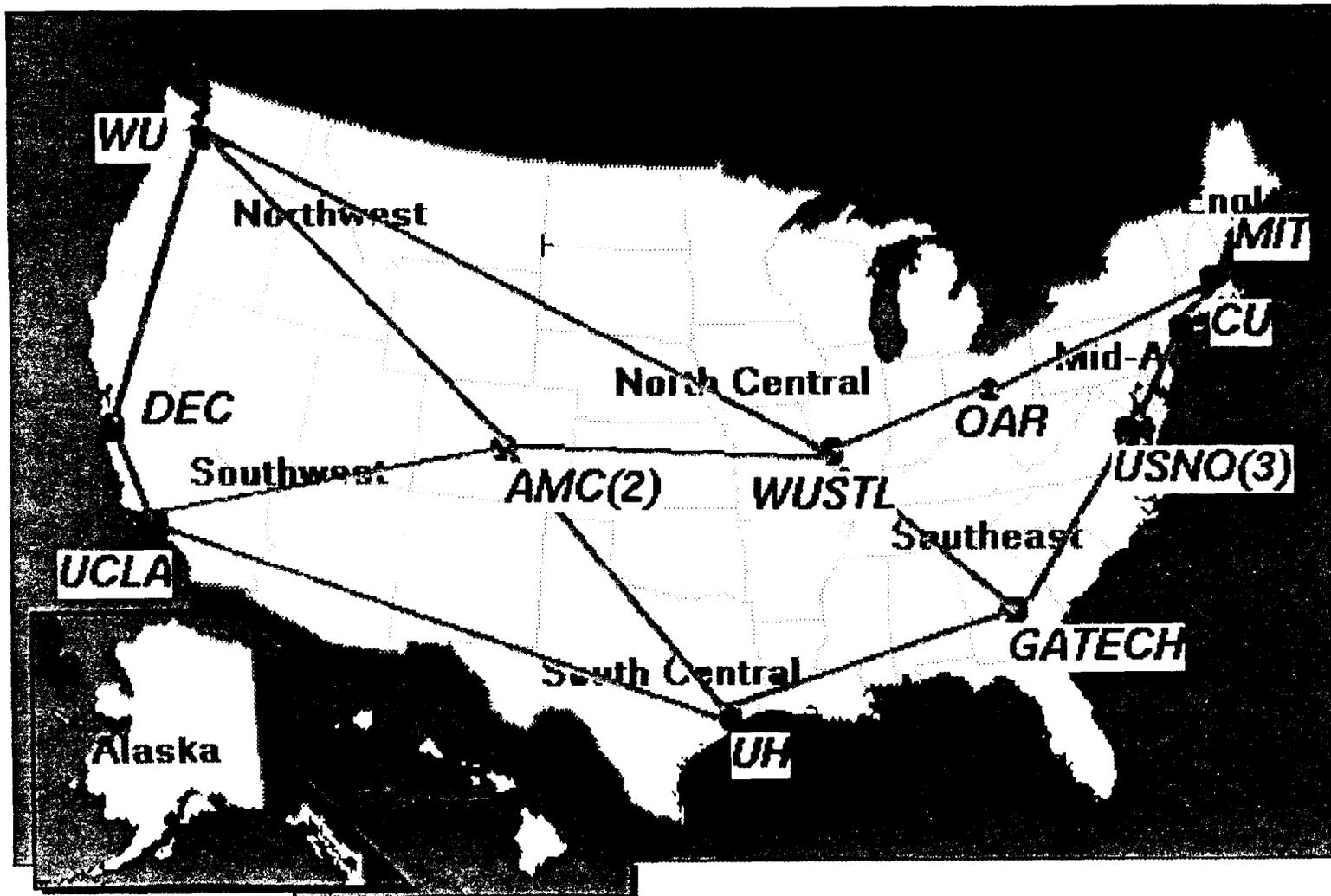
USNO Internet Products

<http://tycho.usno.navy.mil>

- **RealAudio Master Clock Voice Announcer**
 - 75 thousand connections/month
- **Time Service Web server**
 - 4.7 million connections/month (1 .8/second)
- **Anonymous ftp server**
 - 8.4 million connections/month (3.2/second)
- **Network Time Protocol (NTP) statum-1 service**
 - 256 million packets/month (99/second)*
 - *includes 60 million/month via GPS



USNO NTP SERVERS 1997



USNO Network Time Servers

- **Internet**

- **14 U.S. Stratum-1 Time Servers**
 - USNO Master Clock & GPS SPS Time References
 - Hewlett-Packard 700i Industrial Workstations
- **Millisecond Time Synchronization**
- **256 Million Network Requests Per Month**
- **Expansion sites planned for Alaska and Hawaii**

- **Classified DoD Internet (SIPRNET)**

- **2 U.S. Stratum-1 Time Servers**
 - USNO Master Clock References
 - Hewlett-Packard 700i Industrial Workstations
- **Expansion sites planned for Hawaii and Germany**

USNO NTP information available:

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202-762-1578, DSN 762-1578

<http://tycho.usno.navy.mil/ntp.html>



**30th Annual
Precise Time and Time Interval (PTTI)
Systems and Applications Meeting**

PTTI '98

December 1-3, 1998

**Hyatt Regency Hotel
Reston, Virginia**



General Chairman
Don Mitchell
TrueTime, Inc.

Technical Program Chairman
Dennis McCarthy
U.S. Naval Observatory

PTTI Executive Board Chairman
Joseph White
U.S. Naval Research Laboratory

PTTI '98 meeting and registration information
<http://tycho.usno.navy.mil/ptti.html>