

# GPS Time and Frequency Transfer Activities at NIST

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# Common-View Operation at NIST

- Secondary method for contributing NIST time scale to the computation of TAI and UTC
- Time and frequency comparison network in the Inter-American Metrology System (SIM)
- Synchronize clocks in radio stations WWV/WWVB, and WWVH to UTC(NIST)
- Global Time Service
- Time Measurement and Analysis Service (TMAS)

# One-Way Operation at NIST

- Frequency Measurement and Analysis Service (FMAS)
- GPS Disciplined Oscillator and GPS One-Way Receiver Calibration Service
- NIST GPS Data Archive

# Carrier-Phase Operation at NIST

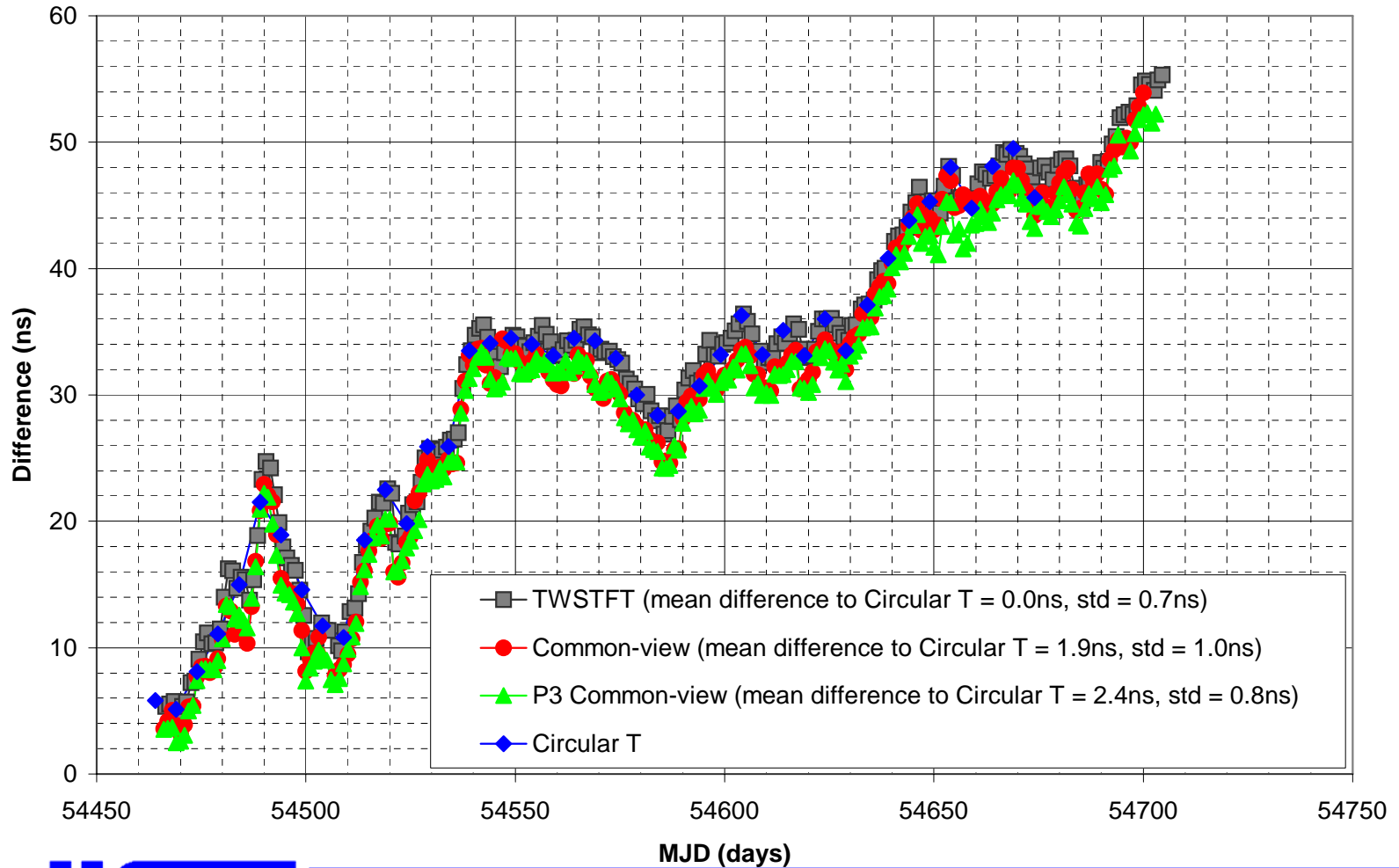
- Two receivers (NISU, NIST) in the IGS tracking network
- Remote clock comparison with the IGS clock products
- Participate in the BIPM TAI PPP pilot project

# Primary GPS Timing Receiver, NIST

- Dual frequency, geodetic-type multi-channel receiver
- Receiver calibrated with respect to the previous primary receiver (NBS10, last calibrated by the BIPM travel receiver in December 2003)
- Receiver recently became our second IGS receiver
- Receiver produces
  - Conventional common-view data
  - RINEX files (data used for P3, carrier-phase time transfer, and for IGS products)

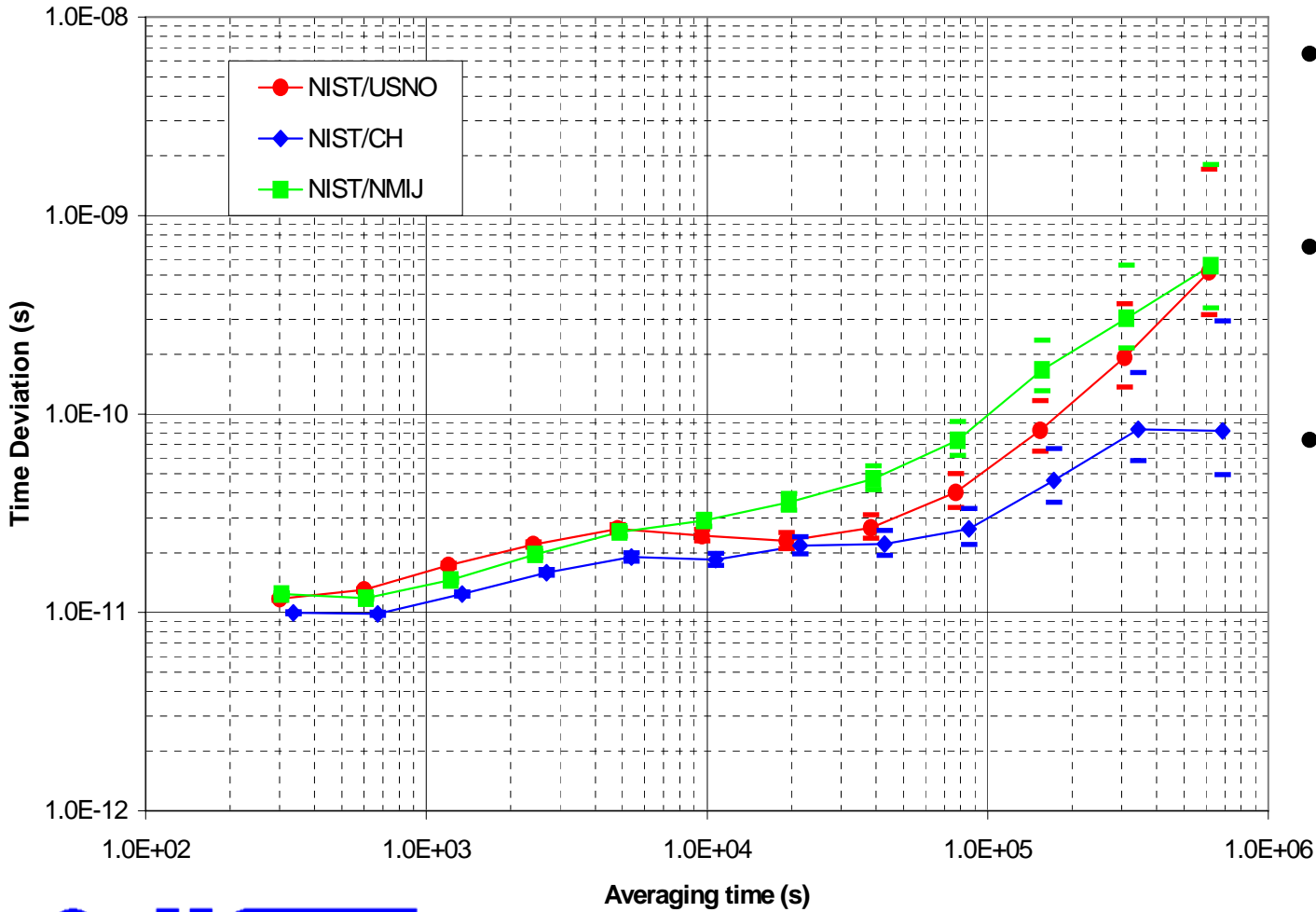
# Primary Receiver Performance

UTC(NIST) - UTC(PTB)



# Primary Receiver Performance

Time Deviation of BIPM 0806 TAIPPP Difference



- NIST/USNO  
 $d \approx 2,400 \text{ km}$
- NIST/CH  
 $d \approx 7,730 \text{ km}$
- NIST/NMIJ  
 $d \approx 8,471 \text{ km}$



# Time and frequency comparison network in the Inter-American Metrology System (SIM)

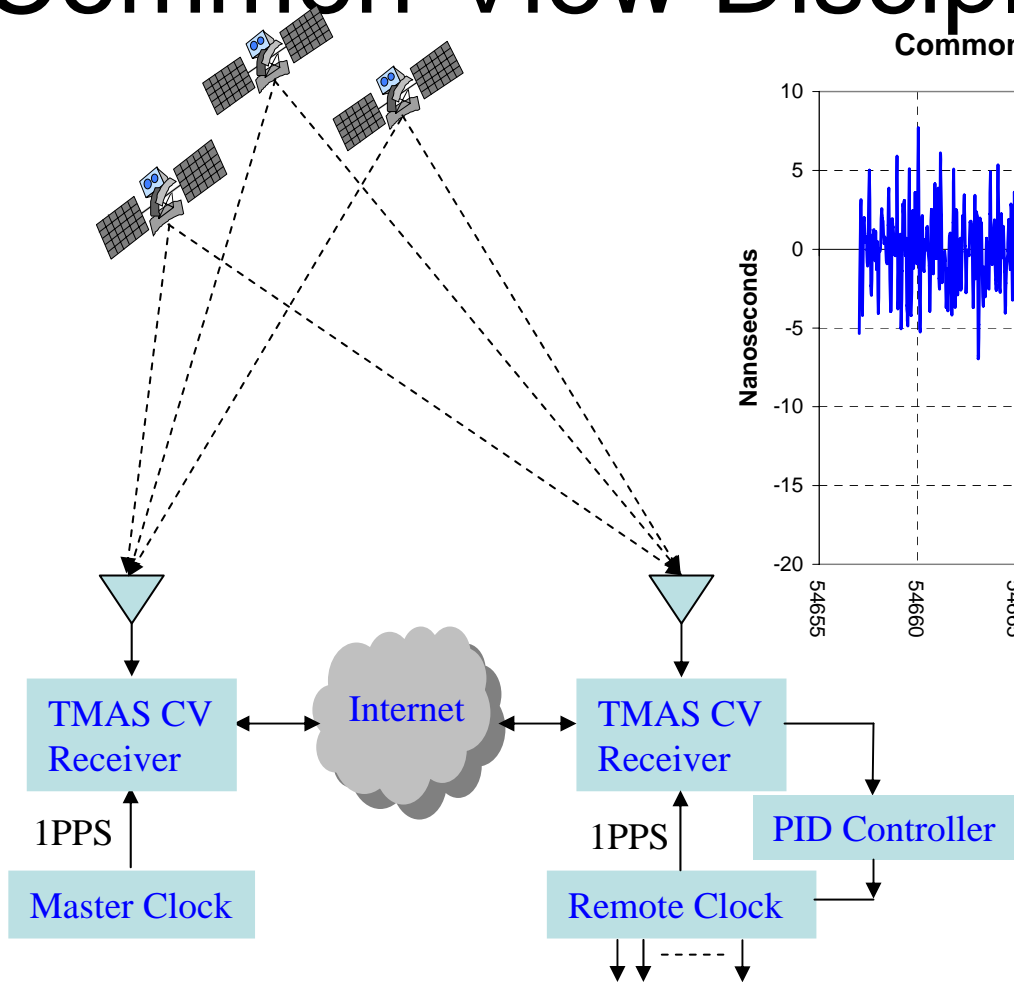
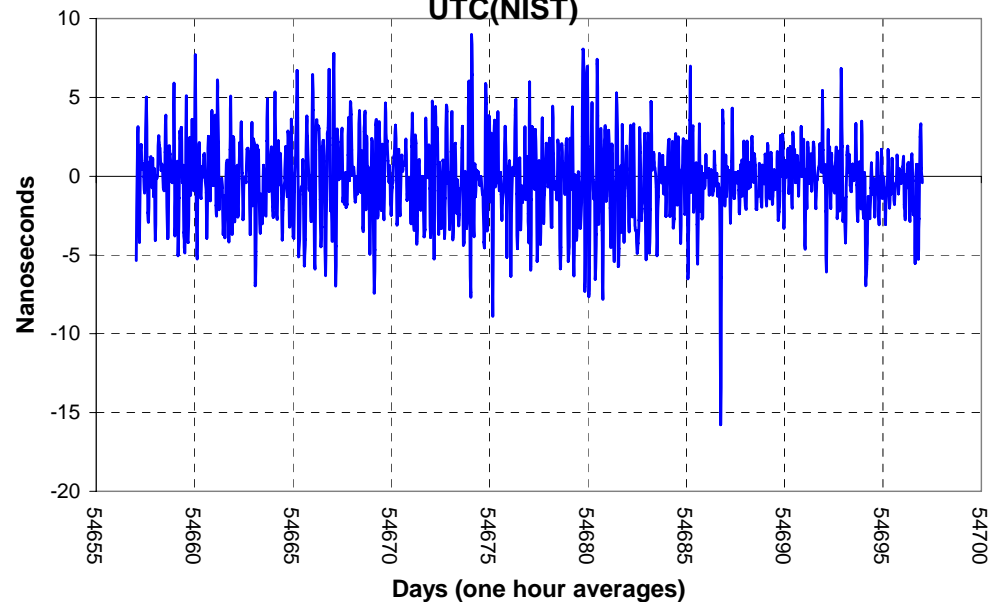
Laboratory and Country	Date of Operation	Reference Clock
NIST (U.S.A)	2005	UTC(NIST)
CNM (Mexico)	April 2005	UTC(CNM)
NRC (Canada)	May 2005	UTC(NRC)
CNMP (Panama)	October 2005	UTC(CNMP)
ONRJ (Brazil)	September 2006	UTC(ONRJ)
Costa Rica	January 2007	Cesium
Colombia	February 2007	Cesium
Argentina	July 2007	Cesium
Guatemala	August 2007	Rubidium
Jamaica	January 2008	Cesium
Uruguay	September 2008	Cesium
Paraguay	September 2008	Rubidium





# Common-View Disciplined Oscillator

Common-View Disciplined Oscillator locked to UTC(NIST)

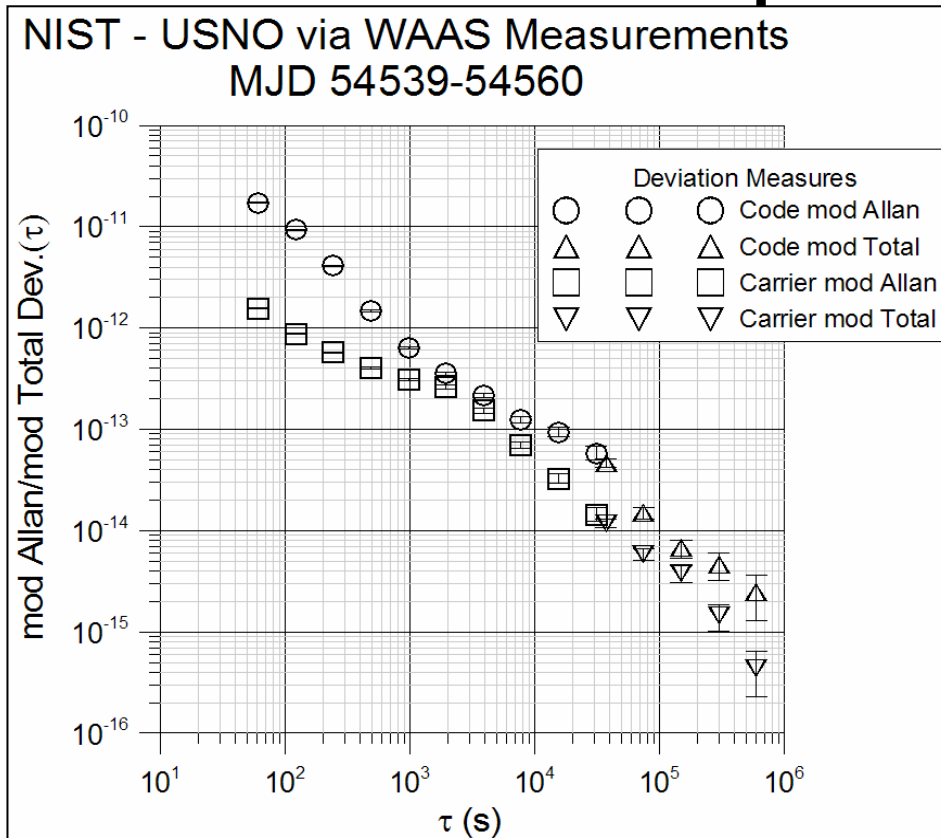


Outputs locked to the master clock

*NIST/USCG LSU joint project of steering a rubidium oscillator to a remote reference clock. Information and plot provided by Michael Lombardi. Study will be reported to PTI 2008.*



# Using WAAS Satellite for Time and Frequency Comparison



- Two geostationary WAAS satellites transmitting the standard GPS L1 and L5 codes and carriers
- Timing labs using parabolic dish antennas to obtain high-gain, low-multipath interference signals without interruption
- Long observation intervals providing the continuous ionosphere-free phase comparison between timing labs

*Proc. 2008 IEEE FCS, "Time and Frequency Transfer Using a WAAS Satellite with L1 and L5 Code and Carrier" by M.A. Weiss, E. Powers, A. Kropp, B. Fonville, P. Fenton, R. Pelletier*

# NIST GPS Time and Frequency Transfer Service

- Frequency Measurement and Analysis Service (FMAS)  
(*Service ID#76100S*)
- Time Measurement and Analysis Service (TMAS)  
(*Service ID#76101S*)
- Global Time Service (*Service ID#76110S*)
- Characterization of Global Positioning System (GPS) Satellite Receivers (*Service ID#76120S*)

[http://ts.nist.gov/ts/htdocs/230/233/calibrations/time\\_freq/broadcast.htm](http://ts.nist.gov/ts/htdocs/230/233/calibrations/time_freq/broadcast.htm)

GPS Data Archive [GPS - UTC(NIST) all-in-view]

<http://tf.nist.gov/service/gpstrace.htm>

