GPS Time and Frequency Transfer Activities at NIST

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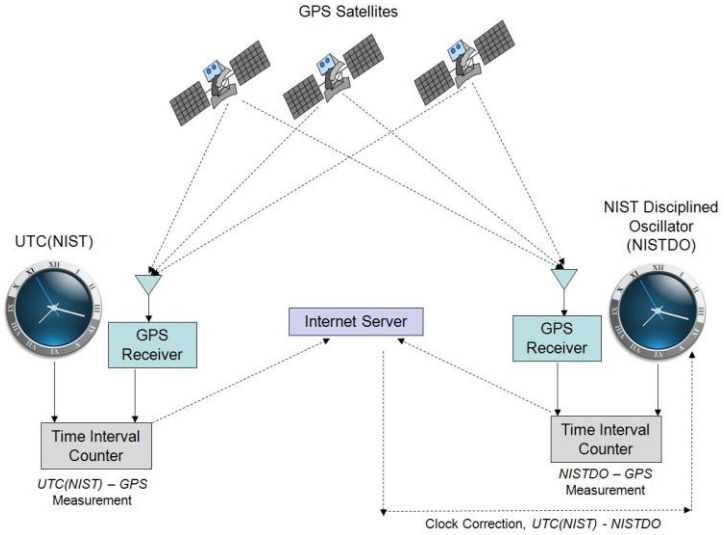
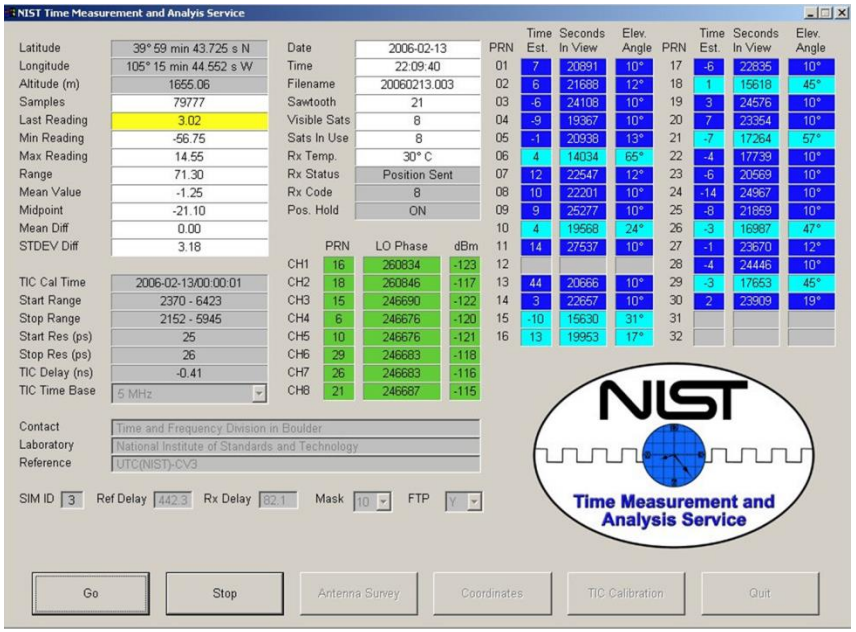
Code-Based Common-View

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

Time Measurement and Analysis Service

- **Steer a remote clock to UTC(NIST) with the TMAS system**
- **The remote clock can be a NIST provided Rb clock or a customer's Cs clock**
- **Steering based on common-view difference every 10 minutes**
- **Averaged time offset < 1 ns, and time uncertainty < 15 ns after 1 day of averaging (k = 2)**





- **Monitor the customer's local time standard by continuously comparing it to the national time standard using GPS common-view**
- **Comparison result is available in every 10 minutes**
- **Time transfer Uncertainty < 15 ns, and frequency uncertainty < 5 x 10^{-14} after 1 day of averaging (k = 2)**

For details of the TMAS, contact Michael Lombardi: michael.lombardi@nist.gov

Code-Based One-Way

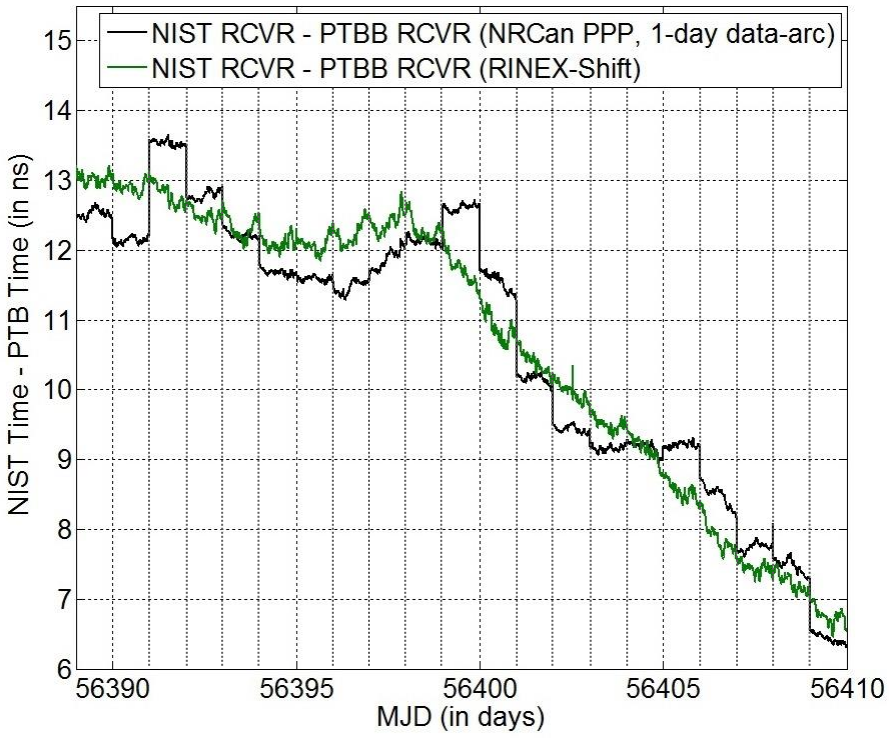
- Frequency Measurement and Analysis Service (FMAS)
- GPS Disciplined Oscillator and GPS One-Way Receiver Calibration Service
- NIST GPS Data Archive

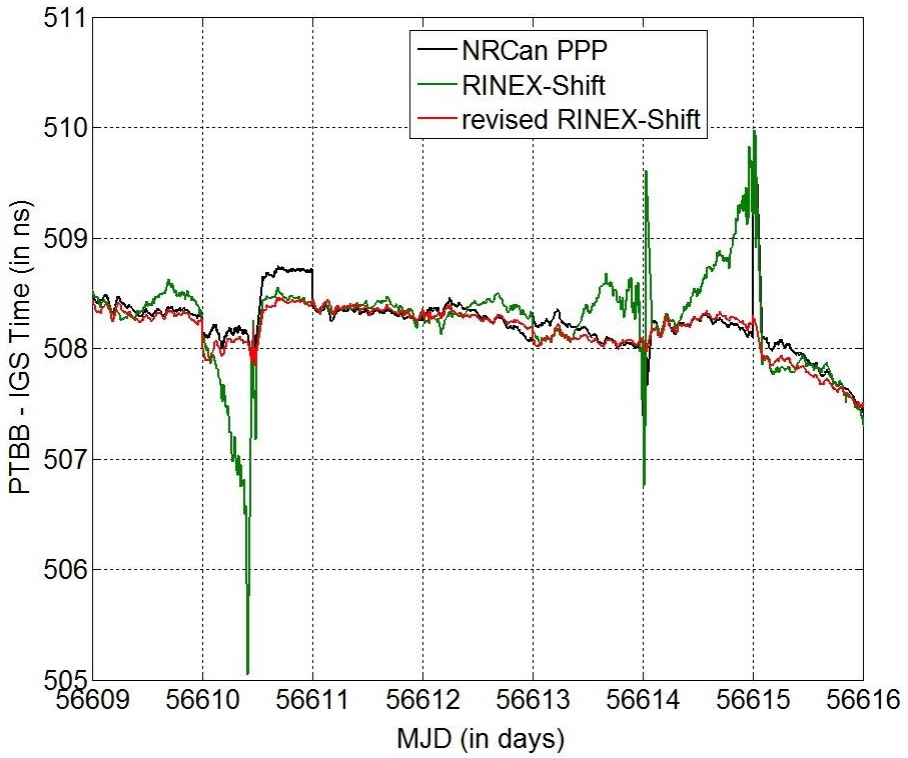
Carrier-Phase (1)

- Contribute NIST time scale to the computation of TAI and UTC, and compare remote clocks with the BIPM TAIPPP results
- Participate in the IGS tracking network
- Compare remote clock with the IGS clock products
- Analyze carrier-phase data for studies of receiver performance and remote clock comparison

Carrier-Phase (2)

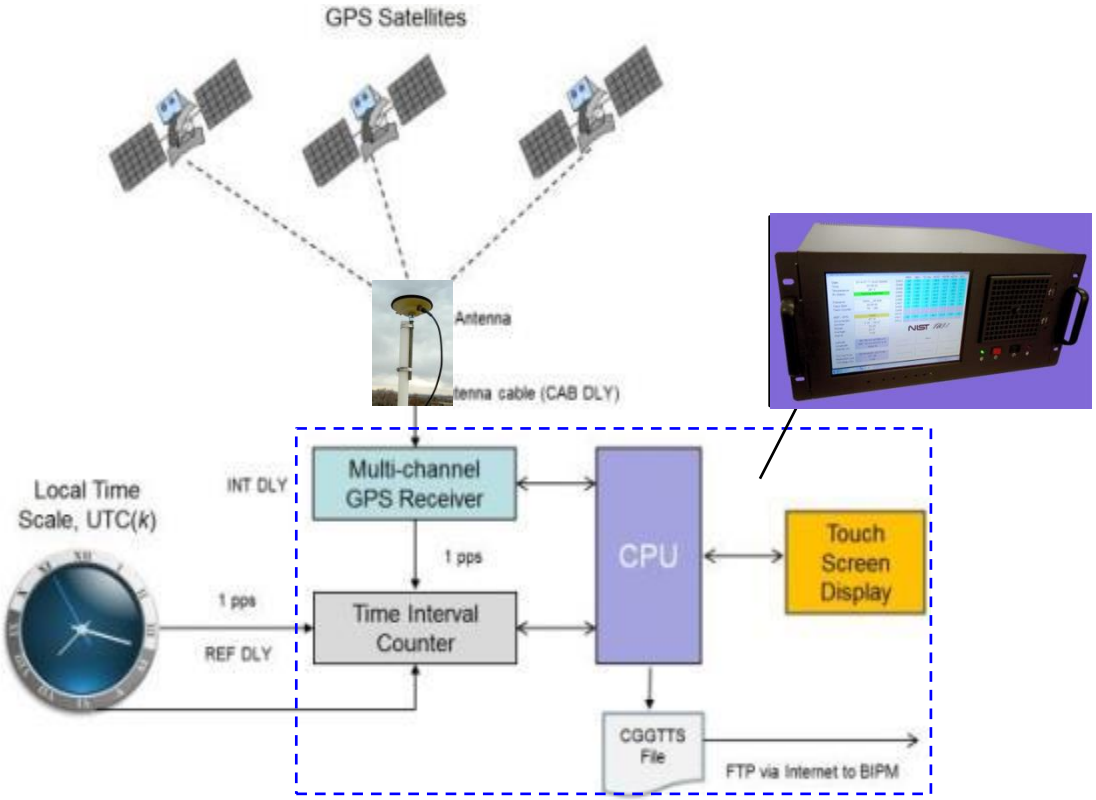
The RINEX-Shift algorithms for minimizing data boundary discontinuity





"An Improvement of RINEX-Shift Algorithm for Continuous GPS Carrier-Phase Time Transfer" to be presented during ION GNSS+ 2014 by Jian Yao and Judah Levine, Contact: jian.yao@boulder.nist.gov

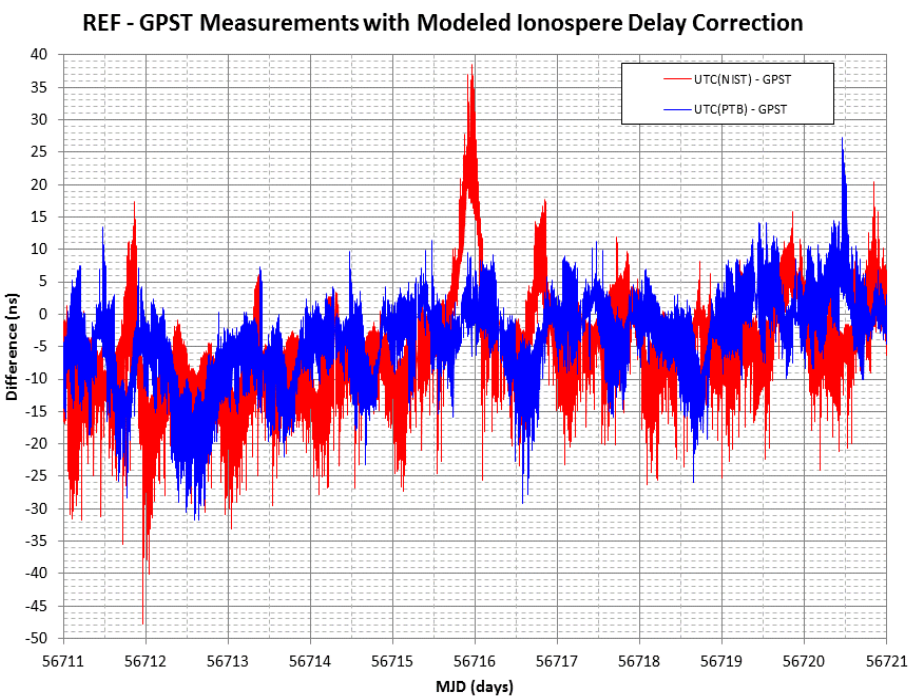
NIST TAI-1 GPS Time Transfer Receiver

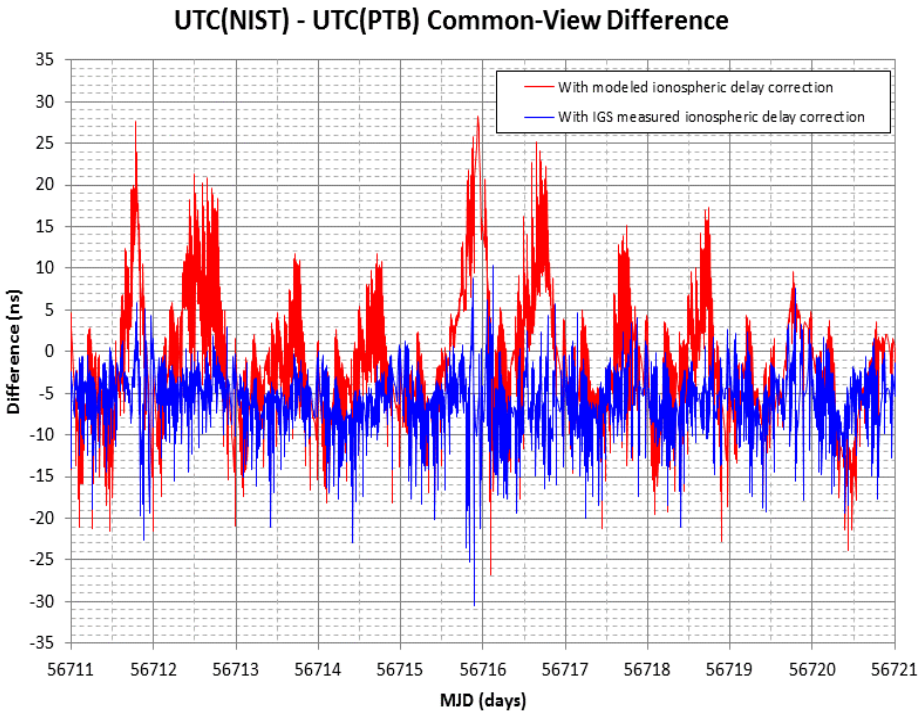


- Low cost, suitable for timing labs with limited resource
- Used for common-view/all-in-view time and frequency transfer
- Able to survey antenna coordinates
- Data in the CGGTTS format, ready for the BIPM TAI/UTC computation
- Time transfer uncertainty < 15ns (k = 2)

For details about the receiver, Contact Michael Lombardi: michael.lombardi@nist.gov

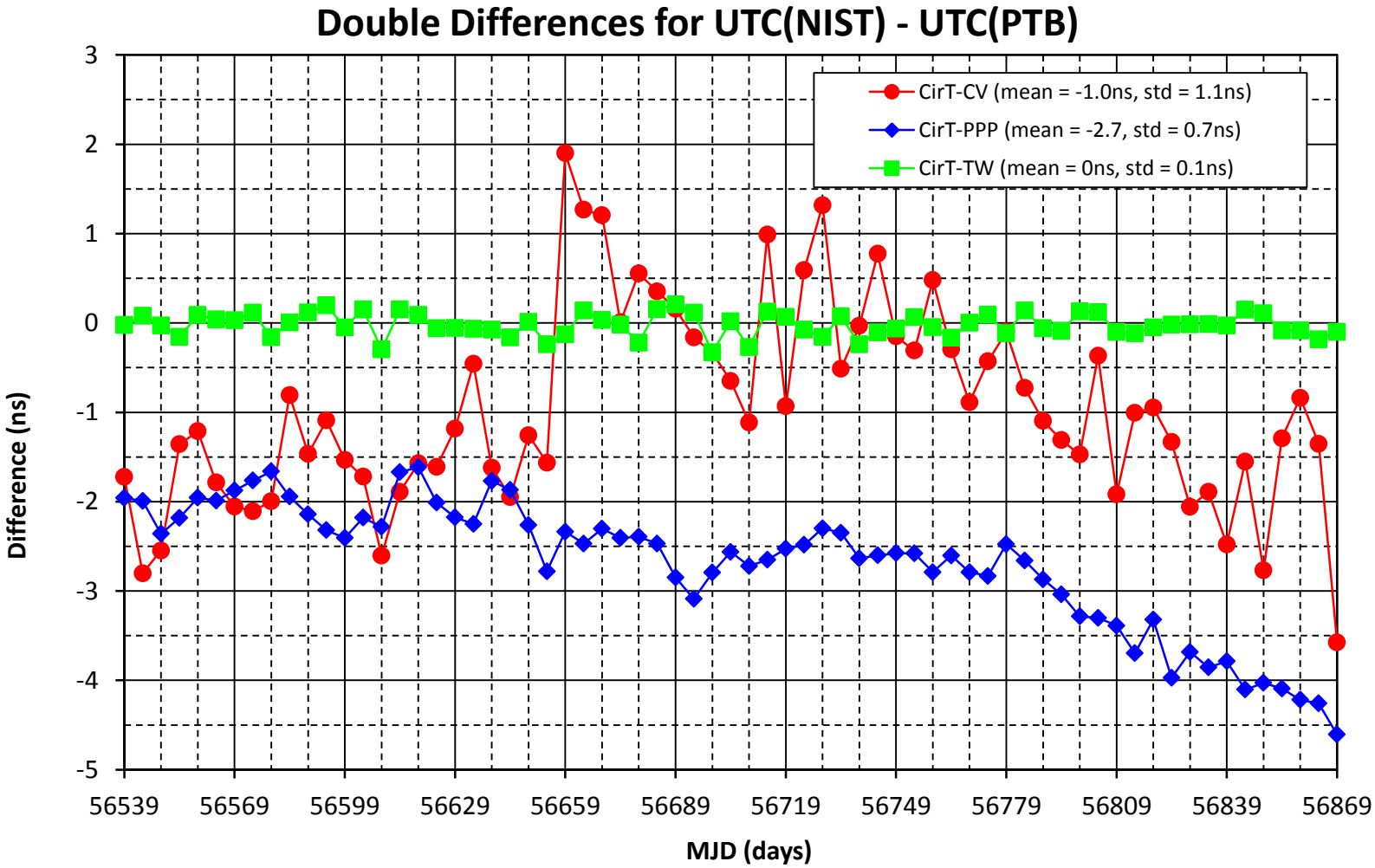
Solar Flare and GPS Time Transfer



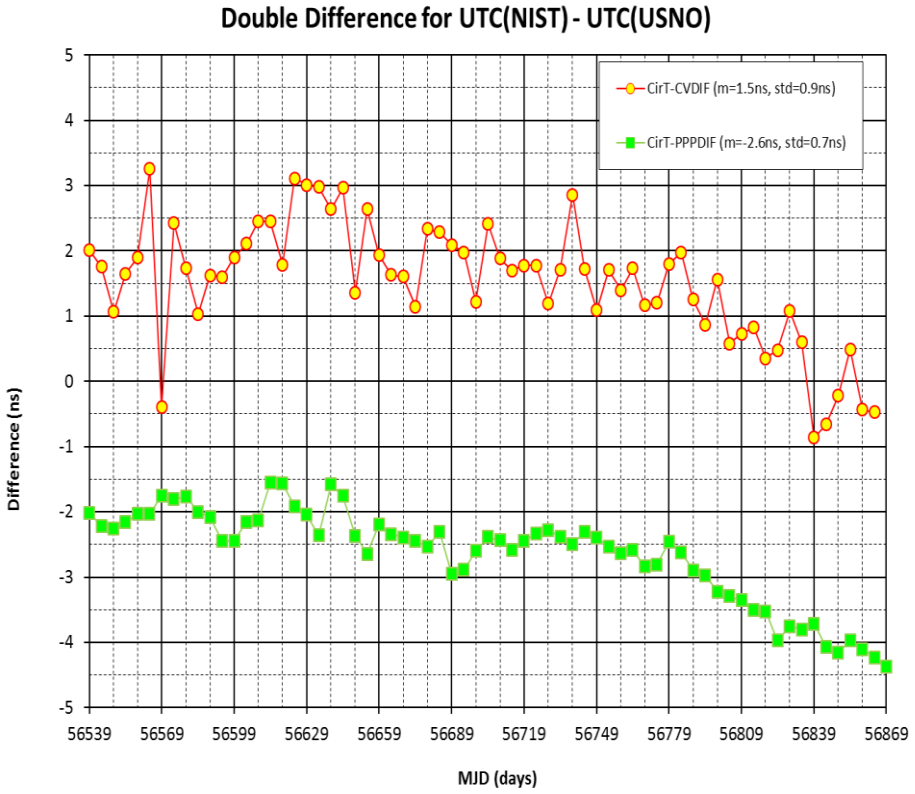


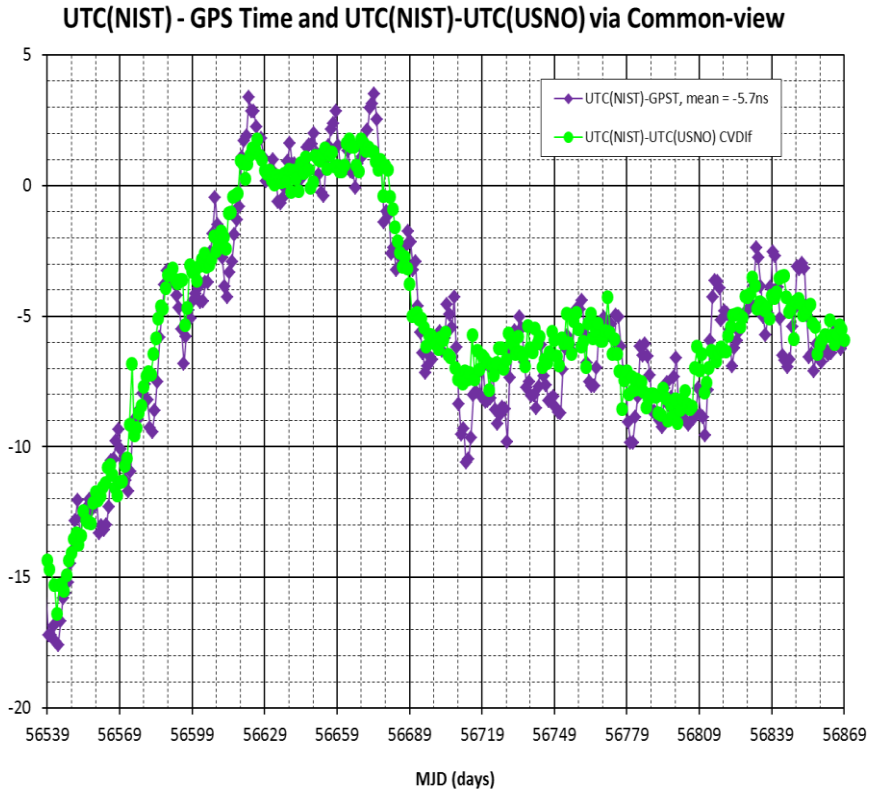
The modeled ionosphere delay correction is effective in dark (nighttime), but inadequate to handle the ionosphere delay change due to the daytime solar activity.

Primary Receiver Performance

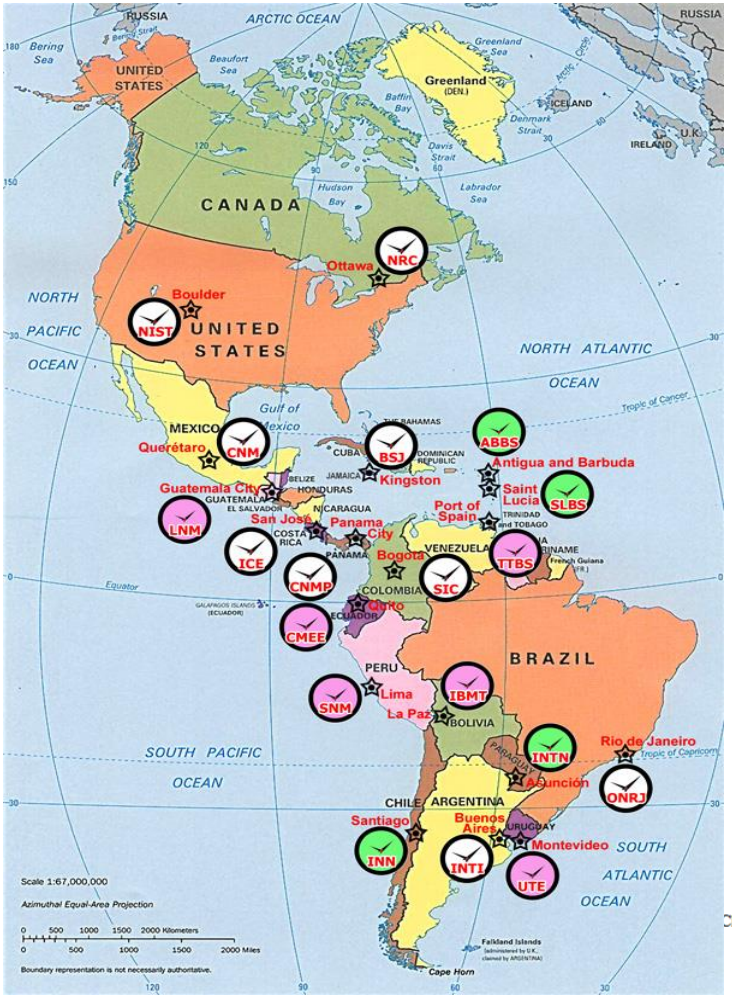


Primary Receiver Performance





Time and Frequency Comparison Network in the Inter-American Metrology System



SIM Time Scale

(SIMT - SIMT(k) for the 1-hour period ending on 2014-08-21 at 20:20:00 UTC)

National Standard	National Flag	SIMT - SIMT(k), ns	SIMT Contribution	National Standard	National Flag	SIMT - SIMT(k), ns	SIMT Contribution
United States SIMT(NIST)		14.54	37.93 %	Uruguay SIMT(UTE)		---	0.00 %
Canada SIMT(NRC)		-42.34	22.77 %	Paraguay SIMT(INTN)		-16.55	0.00 %
Mexico SIMT(CNM)		-5.90	10.06 %	Trinidad SIMT(TTBS)		272.64	0.00 %
Brazil SIMT(ONRJ)		4.46	8.81 %	St. Lucia SIMT(SLBS)		20.04	0.00 %
Costa Rica SIMT(ICE)		-109.66	6.20 %	Chile SIMT(INN)		14.44	0.00 %
Peru SIMT(SNM)		35.69	4.79 %	Antigua SIMT(ABBS)		6.34	0.00 %
Argentina SIMT(INTI)		-9.63	3.53 %	Ecuador SIMT(CMEE)		122.24	0.00 %
Colombia SIMT(INM)		-115.01	3.31 %	Bolivia SIMT(IBMET)		35.34	0.00 %
Panama SIMT(CNMP)		-14.72	2.57 %	St. Kitts SIMT(SKNBS)		---	0.00 %
Guatemala SIMT(LNM)		---	0.00 %	Guyana SIMT(GNBS)		---	0.00 %
Jamaica SIMT(BSJ)		---	0.00 %	Belize SIMT(BBS)		---	0.00 %

Click on a SIMT - SIMT(k) value to view today's graph. New values are computed at 30 minutes after the hour. This table was updated at 21:23:11 UTC and refreshes every 30 minutes.

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

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

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