SIM Report for the 21th CCTF meeting

Raul Fernando Solis Betancur, CENAMEP, Chair of the SIM Time and Frequency Working Group.

Dr. Mauricio Lopez, Chair of the CCTF-MRA.

SIM

- Groups 34 NMI, 20 DI and 3 observers organizations.
- Is divided in 5 sub regions.
- Under the MRA, SIM has 20 NMI and 4 DI time laboratories. But has 30 time laboratories (NMI with no signed MRA and other organizations).

SIM WG on TF in numbers

- 8 laboratories participating in key comparison CCTF-K001.UTC (7 NMI and 1 DI):
  - 1 laboratory with TWGPPP, 4 with GPSPPP and 3 with GPS MC.
- 9 countries have CMC registered in the KCDB (7 NMI and 2 DI).
- 4 NMI are directly involved in investigation of new standards and time transfer technologies (3 are from NORAMET).

Comparison participation

Time Laboratory	UTC Acronym	Country	UTC	UTCr
NRC	NRC	Canada	Yes	Yes
APL	APL	United States	Yes	No
NIST	NIST	United States	Yes	Yes
NRL	NRL	United States	Yes	Yes
USNO	USNO	United States	Yes	Yes
CENAM	CNM	Mexico	Yes	Yes
CENAMEP AIP	CNMP	Panama	Yes	Yes
INACAL	INCP	Peru	Yes	No
INMETRO	INXE	Brazil	Yes	Yes
ONRJ	ONRJ	Brazil	Yes	Yes
INTI	INTI	Argentina	Yes	Yes
ONBA	ONBA	Argentina	Yes	No
IGNA**	IGNA	Argentina	Yes	No
TCC**	TCC	Chile	Yes	No

*NMI in red. DI in blue, other organizations in green.
** No active since for more than two year.

Participation

- We are waiting for INM (a NMI from Colombia) and ICE (a DI from Costa Rica) to start sending their data to the BIPM:
  - ICE and INM have now their codes for the local realization of UTC, UTC(INM) and UTC(ICE).
- UTE (a DI from Uruguay) show interest in become the DI in Time and Frequency and start to participating in UTC in the last part of 2017.
- We estimate that in 2018 SIM have 11 time laboratories participating in UTC.

SIM regional projects

- SIM Time Network.
- SIM Time scale.
- SIM NTP server comparison.
- GPS receivers calibration campaign.
- SIM Time and Frequency Working Group webpage.

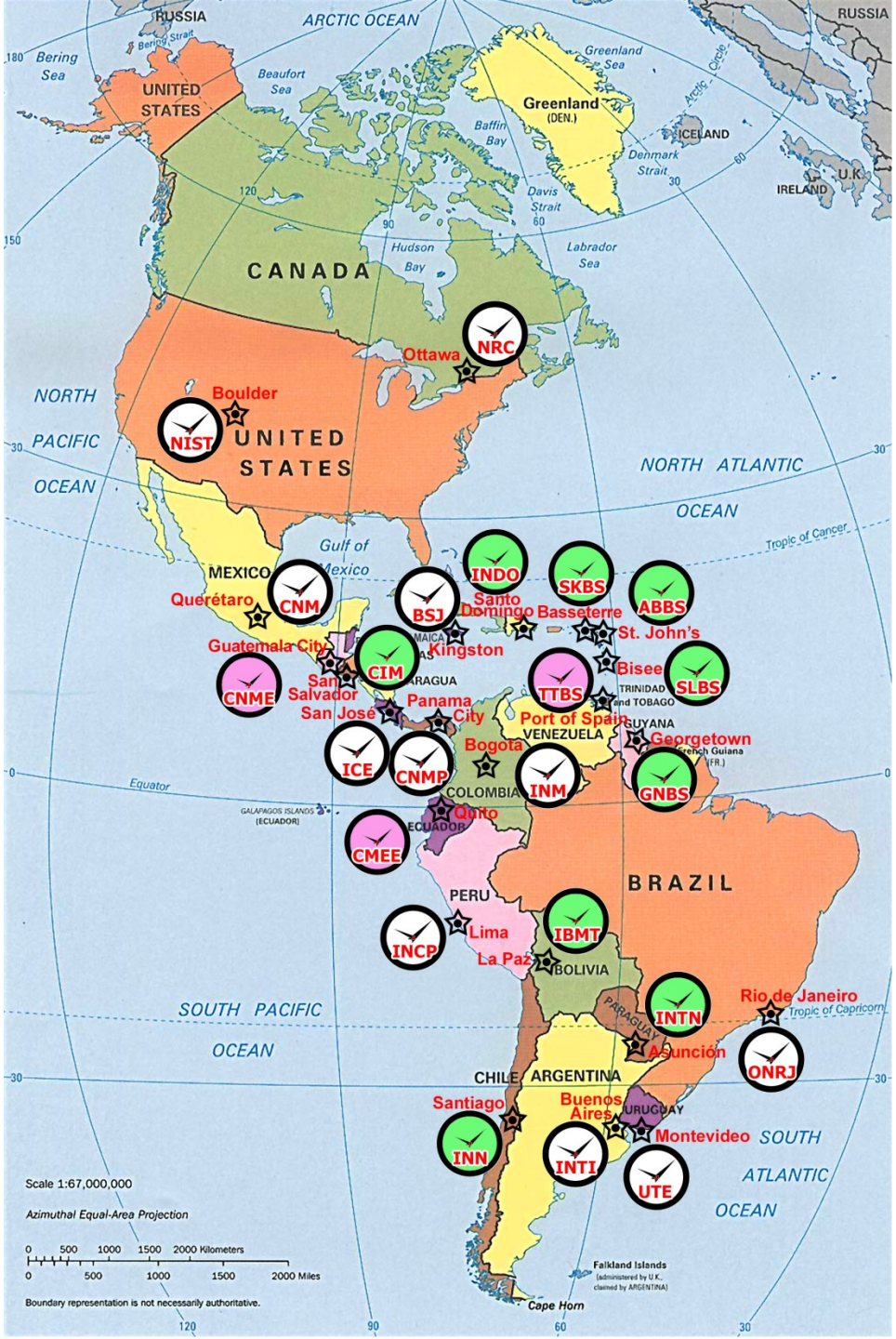
SIM Time Network

- A example of regional collaboration to improve the metrological capabilities of the SIM laboratories.
- The network started in 2005 with 4 time laboratories. In 2017 the network has 23 time laboratories.
- Help to evidence traceability using bilateral comparisons with laboratories with their local realizations of UTC.
- Encourage the laboratories to participate in UTC comparison (INTI and INACAL are using the same receiver to report to UTC).

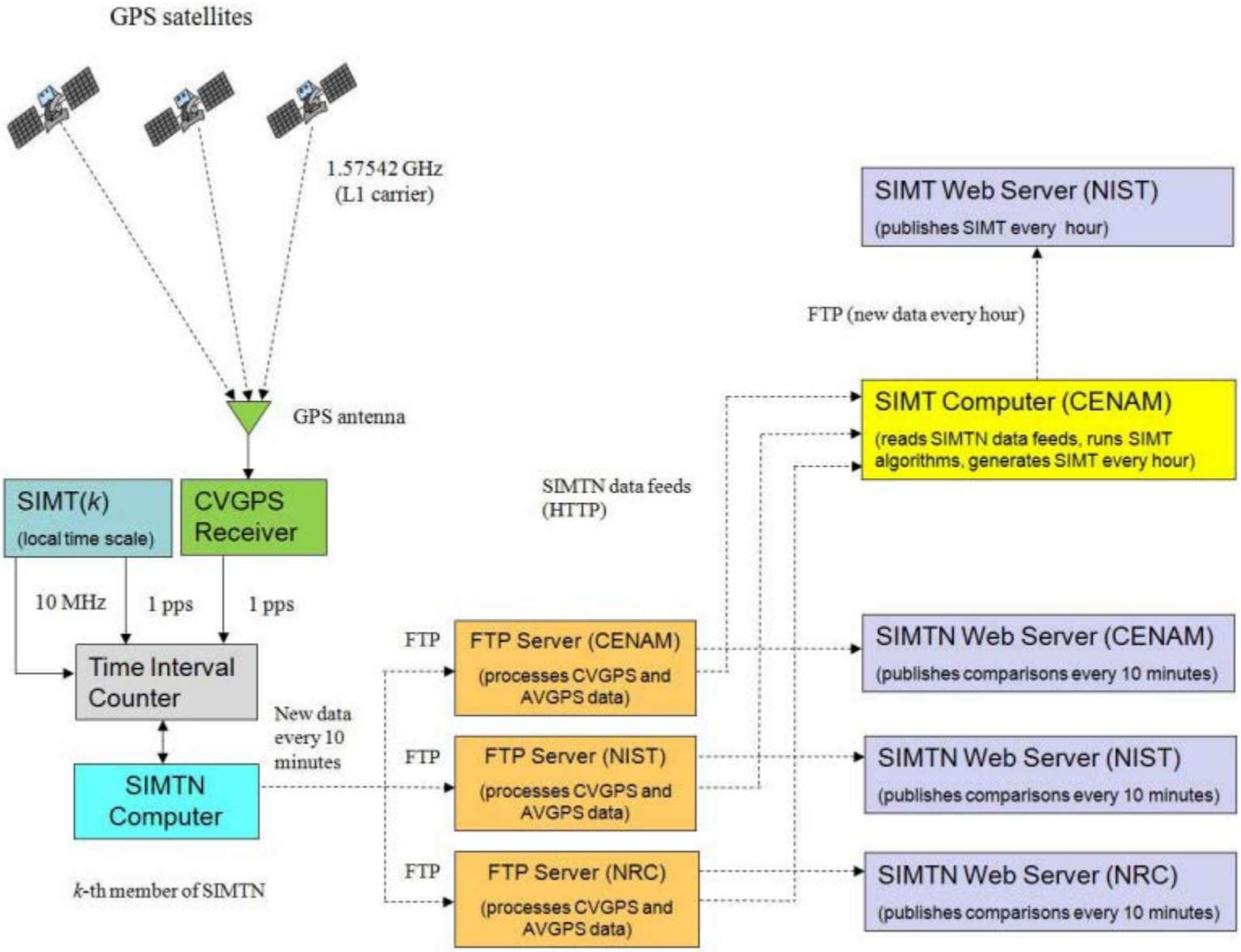
SIM Time Network

Country	Year of first participation	Time Standard
United States	2005	Ensemble time scale
Mexico	2005	Ensemble time scale
Canada	2005	Ensemble time scale
Panama	2005	Cesium
Brazil	2006	Ensemble time scale
Costa Rica	2007	Cesium
Colombia	2007	Cesium
Argentina	2007	Cesium
Guatemala	2007	GPSDO
Jamaica	2007	Cesium
Uruguay	2008	Cesium
Paraguay	2008	Rubidium
Peru	2009	Cesium
Trinidad & Tobago	2009	GPSDO
Saint Lucia	2010	Rubidium
Chile	2010	Rubidium
Antigua and Barbuda	2011	Rubidium
Ecuador	2012	GPSDO
Bolivia	2012	Rubidium
St. Kitts & Nevis	2014	Rubidium
Guyana	2015	Rubidium
El Salvador	2015	Rubidium
Dominican Republic	2015	Rubidium

- White clocks are Cesium, Hydrogen maser or ensemble timescales.
- Green clocks are rubidium clocks that are automatically disciplined to agree with SIMT.
- Purple clocks are either a GPS disciplined clock or an undisciplined rubidium clock.



SIM Time Network



SIM Time Network

	United States SIMT(NIST)	Mexico SIMT(CNM)	Canada SIMT(NRC)	Panama SIMT(CNMP)	Brazil SIMT(ONRJ)	Costa Rica SIMT(ICE)	Colombia SIMT(INM)	Argentina SIMT(INTI)	Guatemala SIMT(CNME)	Jamaica SIMT(BSJ)	Uruguay SIMT(UTE)	Paraguay SIMT(INTN)	Peru SIMT(INCP)	Trinidad SIMT(TTBS)	St. Lucia SIMT(SLBS)	Chile SIMT(INN)
United States SIMT(NIST)		8.9	-4.1	24.3	3.2	28.5	94.1		-13.9			-9316.9	-98.3	-263.4		18.6
Mexico SIMT(CNM)	-8.9		-4.9	17.3	-13.6	18.6	83.5	-34.6	-21.0			-9329.1	-120.5	-269.4		-5.4
Canada SIMT(NRC)	4.1	4.9		22.9	6.2	26.6	98.4	-30.8	-11.7			-9314.2	-98.4	-263.3		18.9
Panama SIMT(CNMP)	-24.3	-17.3	-22.9		-23.9	3.6	69.8	-53.2	-35.2			-9341.7	-124.1	-284.8		-11.5
Brazil SIMT(ONRJ)	-3.2	13.6	-6.2	23.9		27.3	88.5	-35.6	-12.9			-9326.0	-105.4	-260.0		15.4
Costa Rica SIMT(ICE)	-28.5	-18.6	-26.6	-3.6	-27.3		66.3	-55.8	-39.6			-9345.7	-128.1	-289.2		-15.4
Colombia SIMT(INM)	-94.1	-83.5	-98.4	-69.8	-88.5	-66.3		-119.1	-106.8			-9411.4	-193.6	-351.6		-78.2
Argentina SIMT(INTI)		34.6	30.8	53.2	35.6	55.8	119.1		20.9			-9287.8	-69.1	-224.4		56.1
Guatemala SIMT(CNME)	13.9	21.0	11.7	35.2	12.9	39.6	106.8	-20.9				-9306.8	-89.2	-249.6		27.4
Jamaica SIMT(BSJ)																
Uruguay SIMT(UTE)																
Paraguay SIMT(INTN)	9316.9	9329.1	9314.2	9341.7	9326.0	9345.7	9411.4	9287.8	9306.8				9217.7	9060.8		9336.5
Peru SIMT(INCP)	98.3	120.5	98.4	124.1	105.4	128.1	193.6	69.1	89.2			-9217.7		-155.8		118.5
Trinidad SIMT(TTBS)	263.4	269.4	263.3	284.8	260.0	289.2	351.6	224.4	249.6			-9060.8	155.8			272.3
St. Lucia SIMT(SLBS)																
Chile SIMT(INN)	-18.6	5.4	-18.9	11.5	-15.4	15.4	78.2	-56.1	-27.4			-9336.5	-118.5	-272.3		

SIM Time Network

- 16 time laboratories (70 % of SIM) obtain traceability through the SIM Time Network.
- 3 Country (Peru, Costa Rica and Colombia) claimed CMC using bilateral comparisons with NMI with UTC(k) and CMCs in the network.

Country	Is MRA signatory?
Costa Rica	Yes
Colombia	Yes
Guatemala	No
Jamaica	Yes
Uruguay	Yes
Paraguay	Yes
Trinidad & Tobago	Yes
Saint Lucia	Yes
Chile	Yes
Antigua and Barbuda	Yes
Ecuador	Yes
Bolivia	Yes
St. Kitts & Nevis	Yes
Guyana	Yes
El Salvador	No
Dominican Republic	No

SIM Time scale

(SIMT - SIMT(*k*) for the 1-hour period ending on 2017-04-05 at 00:20:00 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)		6.91	34.25 %	Antigua SIMT(ABBS)		—	0.00 %
Brazil SIMT(ONRJ)		11.55	17.30 %	Guyana SIMT(GNBS)		—	0.00 %
Mexico SIMT(CNM)		20.21	16.91 %	El Salvador SIMT(CIM)		—	0.00 %
Canada SIMT(NRC)		7.28	11.75 %	Guatemala SIMT(LNM)		12.91	0.00 %
Costa Rica SIMT(ICE)		20.57	7.15 %	Paraguay SIMT(INTN)		442187669.01	0.00 %
Argentina SIMT(INTI)		66.78	4.99 %	Trinidad SIMT(TTBS)		273.31	0.00 %
Panama SIMT(CNMP)		24.23	3.71 %	Chile SIMT(INN)		225.71	0.00 %
Colombia SIMT(INM)		-49.63	2.86 %	Ecuador SIMT(CMEE)		-19.79	0.00 %
Peru SIMT(INACAL)		165.90	1.08 %	Bolivia SIMT(IBMET)		37.61	0.00 %
Jamaica SIMT(BSJ)		—	0.00 %	St. Kitts SIMT(SKNBS)		19.71	0.00 %
Uruguay SIMT(UTE)		—	0.00 %	Dominican Rep. SIMT(INDOCAL)		9.31	0.00 %
St. Lucia SIMT(SLBS)		—	0.00 %	Bahamas SIMT(BBSQ)		—	0.00 %

SIM Time scale

- A time scale supported by time laboratories with time scales or single running cesium clock.
- A regional project that brings a reference close enough to UTC without competing or seeking to replace UTC:
  - Introduce time laboratories in time scales implementation and management concepts.
  - Useful for laboratories without timescales or lack of knowledge in time prediction.
  - Provides a real-time tool to check the performance of timing laboratories.

NTP servers comparison

- SIM NTP Comparison: A comparison between NTP (Network Time Protocol) servers in SIM.

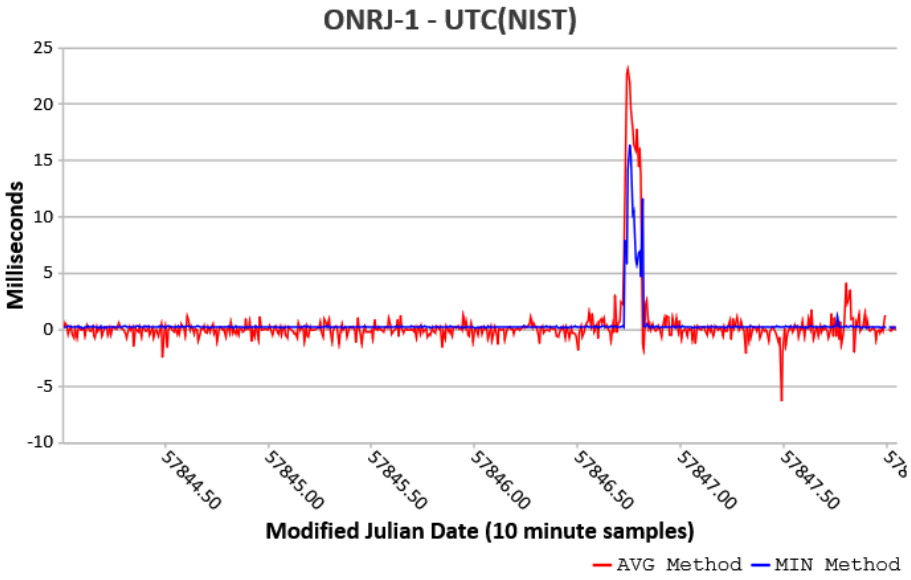
(time differences for the 10-minute period ending on 04-27-2017 at 14:50:00 UTC)

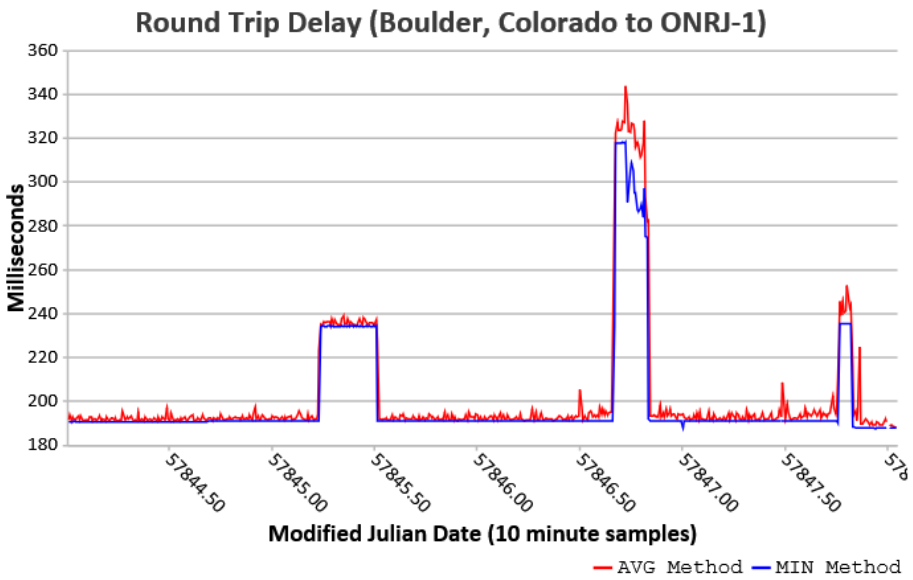
	NIST	NRC	ICE	INM	ONRJ-1	CENAM	IBMET	CNMEP	INACAL	INDOCAL	CMEE
United States		0.1	-1.4	-10.2	0.1	-4.0	804.9	-7.0	-14.3	-11.9	-15.5
Canada	-0.1		-1.6	-10.3	0.0	-4.1	804.8	-7.2	-14.4	-12.1	-15.6
Costa Rica	1.4	1.6		-8.8	1.6	-2.6	806.3	-5.6	-12.9	-10.5	-14.1
Colombia	10.2	10.3	8.8		10.3	6.2	815.1	3.2	-4.1	-1.7	-5.3
Brazil	-0.1	-0.0	-1.6	-10.3		-4.1	804.8	-7.2	-14.4	-12.1	-15.6
Mexico	4.0	4.1	2.6	-6.2	4.1		808.9	-3.1	-10.3	-7.9	-11.5
Bolivia	-804.9	-804.8	-806.3	-815.1	-804.8	-808.9		-811.9	-819.2	-816.8	-820.4
Panama	7.0	7.2	5.6	-3.2	7.2	3.1	811.9		-7.3	-4.9	-8.4
Peru	14.3	14.4	12.9	4.1	14.4	10.3	819.2	7.3		2.4	-1.2
Dominican Rep.	11.9	12.1	10.5	1.7	12.1	7.9	816.8	4.9	-2.4		-3.6
Ecuador	15.5	15.6	14.1	5.3	15.6	11.5	820.4	8.4	1.2	3.6	

This table was created at 04-27-2017 (MJD 57870) 14:56:31 UTC and will refresh every five minutes. Values are in milliseconds, time differences > 50 ms are marked in red.

Click on a server name or :ountry name to graph the time difference between the server and SIMT(NIST). Click on a number to graph the time difference between two servers.

NTP servers comparison





- Provide information about the status of the disseminated time across the network.
- Are very useful for those laboratories that are stating to disseminate their time via NTP.
- Help evidence their operation for legal time.

Time dissemination in SIM

- 12 laboratories have Web clocks.
- 11 laboratories have Internet time through NTP servers.
- 6 laboratories with telephone time services.
- 5 laboratories with radio time code signal services.

Receiver calibration campaign

- First group (G1): USNO and NIST.
- Second group (G2): is divided in two rounds:
  - Round 1: NIST, NRC, CENAM and CENAMEP.
  - Round 2: NIST, ONRJ, INMETRO and INTI.
- In the second group, the round 1 is finished. We are expecting July the starting of the group 2 calibration campaign.

Preserving the knowledge

- NIST administrates and supports the Time and Frequency Working Group Web page (http://tf.nist.gov/sim).
- Keeps information generated from the WG activities:
  - Publications & meetings.
  - Comparisons (Time Network, SIM time scale and NTP).
  - National Web clocks from SIM and
  - extra information about other NMI and organizations.
- We think that being transparent and sharing the knowledge is the best way to advance.

Strong cooperation and coordination program

- A strong training program and coordination in time and frequency (meetings and workshops every 2 years).
- Constant communication between all the participants.
- Development of customized equipment to provide small countries with minimal equipment to have national time and frequency references with traceability to the SI second.

Strong cooperation and coordination program