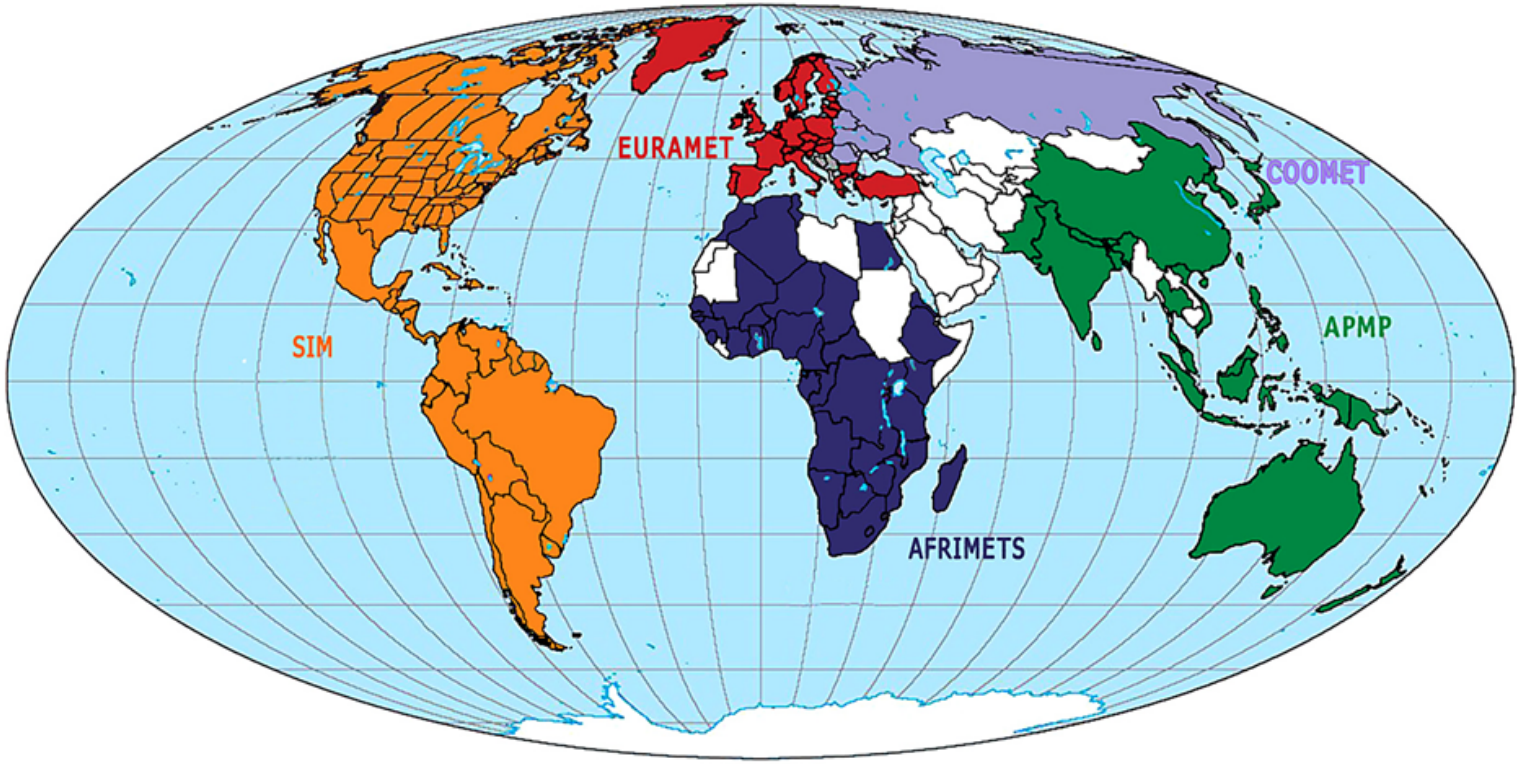
SIM Time Network

Improved time coordination for North, Central and South America

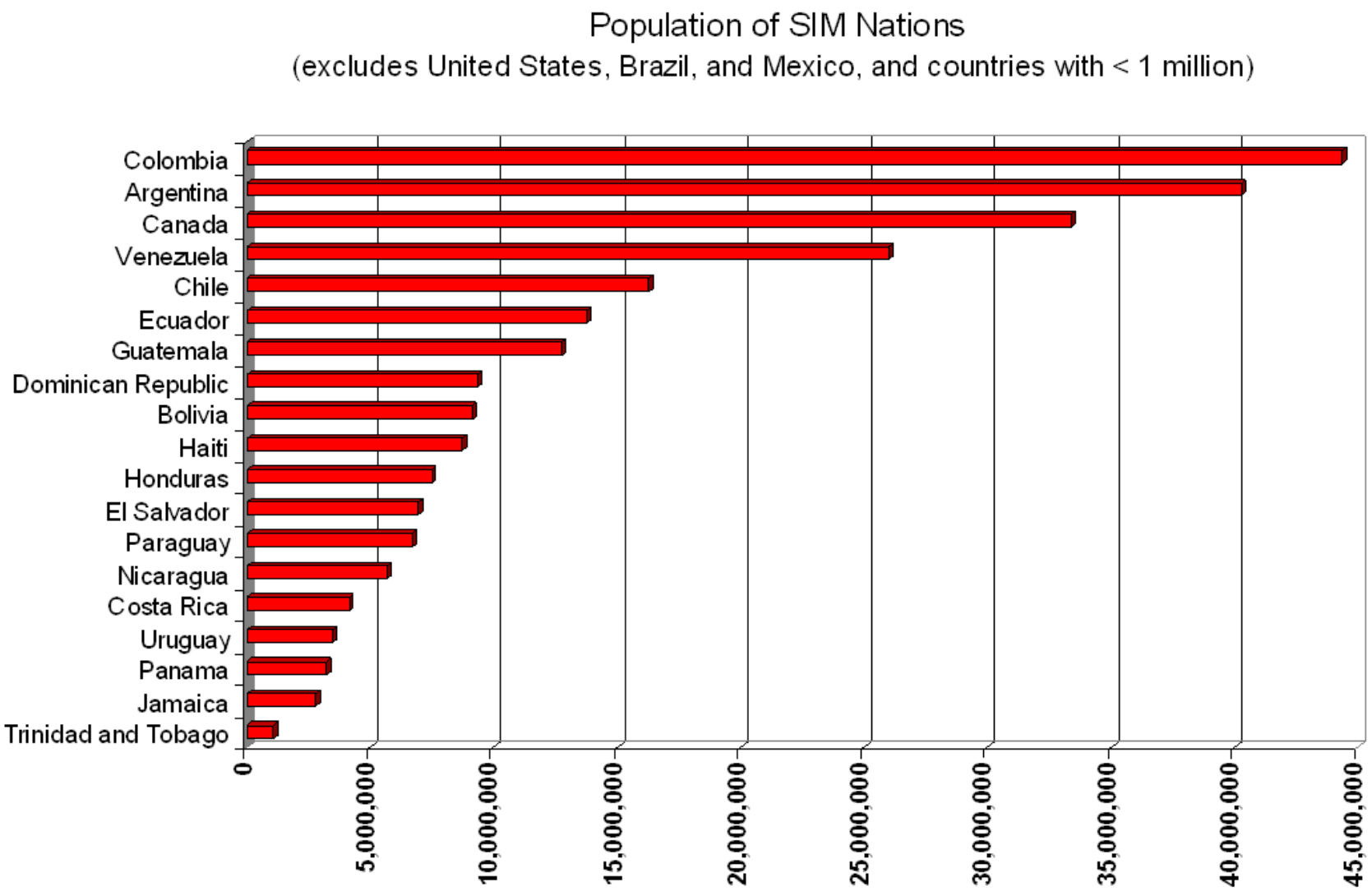
SISTEMA INTERAMERICANO DE METROLOGIA

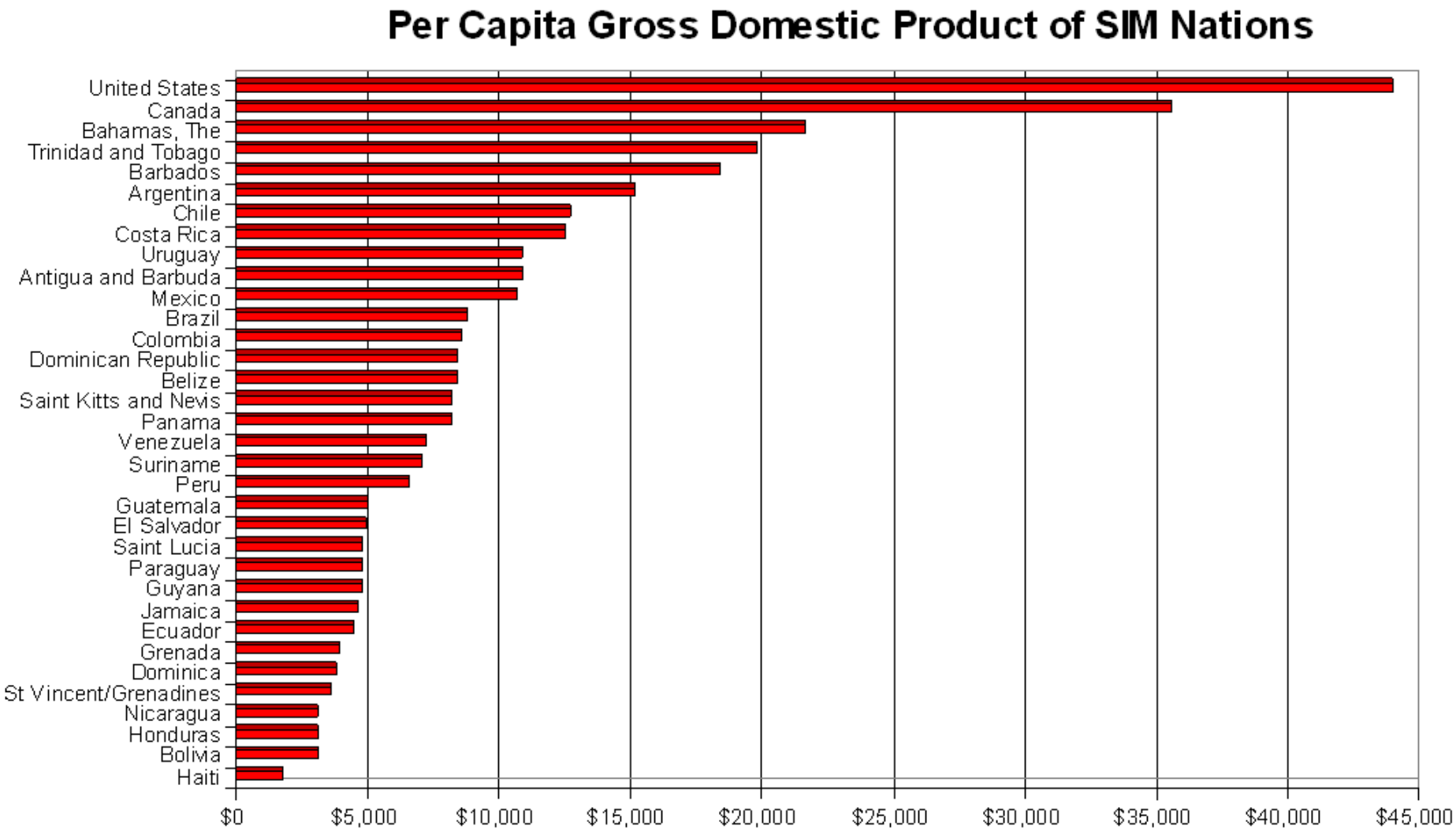
SIM is the Interamerican Metrology System, one of the world's five major Regional Metrology Organizations (RMOs) recognized by the BIPM



Some facts about SIM

- SIM consists of NMIs located in the 34 member nations of the Organization of American States (OAS), which extends throughout North, Central, and South America, and the Caribbean region.
- OAS accounts for roughly 14% of the world's population (more than 920 million people), and roughly 27% of its land mass.
- About 2/3 of the OAS population resides in the United States, Mexico, and Brazil.
- Twelve SIM nations (mostly islands) have populations of less than 1 million.
- SIM is not as well established in the world timekeeping arena as EUROMET or APMP. However, participation from the Americas is on the rise and probably has more potential for future expansion than any other region.
- SIM has organized metrology working groups (MWGs) in 11 different areas, including time and frequency. The SIM Network is operated by the T&F MWG.


Population of SIM Nations
(excludes United States, Brazil, and Mexico, and countries with < 1 million)
Colombia
Argentina
Canada
Venezuela
Chile
Ecuador
Guatemala
Dominican Republic
Bolivia
Haiti
Honduras
El Salvador
Paraguay
Nicaragua
Costa Rica
Uruguay
Panama
Jamaica
Trinidad and Tobago
0
5,000,000
10,000,000
15,000,000
20,000,000
25,000,000
30,000,000
35,000,000
40,000,000
45,000,000


Per Capita Gross Domestic Product of SIM Nations
United States
Canada
Bahamas, The
Trinidad and Tobago
Barbados
Argentina
Chile
Costa Rica
Uruguay
Antigua and Barbuda
Mexico
Brazil
Colombia
Dominican Republic
Belize
Saint Kitts and Nevis
Panama
Venezuela
Suriname
Peru
Guatemala
El Salvador
Saint Lucia
Paraguay
Guyana
Jamaica
Ecuador
Grenada
Dominica
St Vincent/Grenadines
Nicaragua
Honduras
Bolivia
Haiti
$0
$5,000
$10,000
$15,000
$20,000
$25,000
$30,000
$35,000
$40,000
$45,000

SIM Time Network design goals

- To establish cooperation and communication between the SIM time and frequency labs now and in the future.
- To provide the smaller SIM laboratories not involved in other international comparisons (those who do not appear on the *Circular-T*) with a convenient way to compare their standards to the rest of the world so that they can establish measurement traceability to the SI units of time and frequency.
- To make the required equipment low cost and easy to install, operate, and use, because resources at SIM laboratories are limited and staff sizes are small.
- To make measurements with uncertainties that are small enough to characterize the best standards in the SIM region.
- To report measurement results in near real-time, without the processing delays of the *BIPM Circular-T*.
- To build a democratic network that did not favor any single laboratory or nation, and to allow all members to view the results of all comparisons.

SIM measurement system characteristics

- Simple design makes it easy and inexpensive for SIM labs to compare their standards. It includes:
  - 8-channel GPS receiver (C/A code, L1 band)
  - Time interval counter with 30 ps resolution
  - Rack-mount PC and flat panel display
  - Pinwheel type antenna
  - Applies broadcast ionospheric (MDIO) corrections
- Data are not stored in CGGTTS format. The receiver measures all visible satellites and stores 1-minute and 10-minute REFGPS averages.
- All systems are connected to the Internet, and send their files to a web server every 10 minutes.
- The web server processes data "on the fly" in near real-time. Results can be viewed on the web in either common-view or all-in-view format.
- All units are built and calibrated at NIST
- Systems are paid for by either OAS or the participating NMI and become the property of the NMI.

SIM
SISTEMA INTERAMERICANO DE METROLOGIA

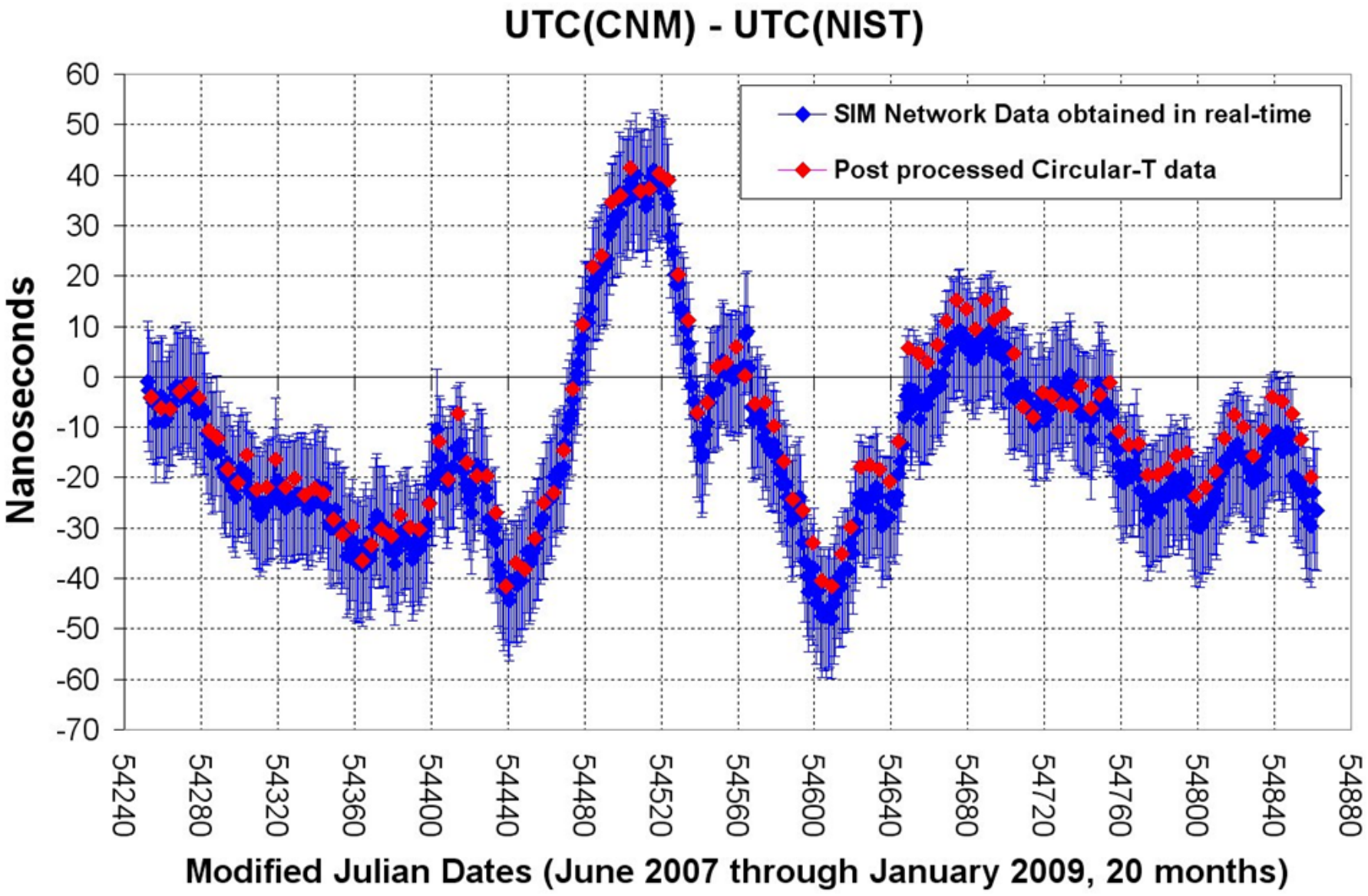
SIM Time Network uncertainty analysis

Table 3. Measurement Uncertainties (nanoseconds).

Uncertainty Component	Best Case	Worst Case	Typical
U_A, $\sigma_x(\tau)$, τ = 1 d	0.7	5	1.5
U_B, Calibration	1	4	2
U_B, Coordinates	1	25	3
U_B, Environment	2.5	4	3
U_B, Multipath	1.5	5	2
U_B, Ionosphere	1	3.5	2
U_B, Ref. Delay	0.5	2	1
U_B, Resolution	0.05	0.05	0.05
U_C, k = 2	7.0	53.8	11.5

$$U_c = k\sqrt{U_a^2 + U_b^2}$$

- Uncertainties are expressed using a method complaint with the ISO GUM standard.
- We use the time deviation (TDEV) at an averaging time of 1 day as our Type A uncertainty (1.5 ns in this example).
- Type B uncertainties are summarized in the table.
- Combined standard uncertainty (k = 2) is typically less than 15 nanoseconds for time, and $< 1 \times 10^{-13}$ for frequency after 1 day of averaging.


UTC(CNM) - UTC(NIST)
SIM Network Data obtained in real-time
Post processed Circular-T data
Nanoseconds
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
54240
54280
54320
54360
54400
54440
54480
54520
54560
54600
54640
54680
54720
54760
54800
54840
54880
Modified Julian Dates (June 2007 through January 2009, 20 months)

United States, 2005

Mexico, 2005

Canada, 2005

Panama, 2005

Brazil, 2006

Costa Rica, 2007

Colombia, 2007

Argentina, 2007

Guatemala, 2007

Jamaica, 2007

Uruguay, 2008

Paraguay, 2008

Peru, 2009

Trididad & Tobago, 2009

Chile, 2010

Saint Lucia, 2010

SIM Time Network

(real-time measurement results for the 10-minute period ending on 02-26-2009 at 1710 UTC)

SIM SISTEMA INTERAMERICANO DE METROLOGIA	United States UTC(NIST)	Mexico UTC(CNM)	Canada UTC(NRC)	Panama UTC(CNMP)	Brazil UTC(ONRJ)	Costa Rica UTC(ICE)	Colombia UTC(SIC)	Argentina UTC(INTI)	Guatemala UTC(LNM)	Jamaica UTC(BSJ)	Uruguay UTC(UTE)	Paraguay UTC(INTN)
United States UTC(NIST)		-21.6	-13.0	-4.7	-0.9	271.4	13.9	412.0		1.1	-145.8	-1242.9
Mexico UTC(CNM)	21.6		10.1	16.6	19.7	292.5	35.7	429.4		22.9	-128.4	-1223.4
Canada UTC(NRC)	13.0	-10.1		7.5	10.0	284.1	27.2	427.1		14.8	-133.5	-1229.5
Panama UTC(CNMP)	4.7	-16.6	-7.5		2.7	275.9	18.1	412.8		5.3	-145.0	-1241.2
Brazil UTC(ONRJ)	0.9	-19.7	-10.0	-2.7		281.9	20.1	413.1		11.5	-147.8	-1241.2
Costa Rica UTC(ICE)	-271.4	-292.5	-284.1	-275.9	-281.9		-260.6	133.9		-269.4	-423.9	-1518.9
Colombia UTC(SIC)	-13.9	-35.7	-27.2	-18.1	-20.1	260.6		393.1		-9.7	-164.8	-1259.6
Argentina UTC(INTI)	-412.0	-429.4	-427.1	-412.8	-413.1	-133.9	-393.1			-406.0	-559.4	-1655.4
Guatemala UTC(LNM)												
Jamaica UTC(BSJ)	-1.1	-22.9	-14.8	-5.3	-11.5	269.4	9.7	406.0			-151.8	-1248.2
Uruguay UTC(UTE)	145.8	128.4	133.5	145.0	147.8	423.9	164.8	559.4		151.8		-1096.5
Paraguay UTC(INTN)	1242.9	1223.4	1229.5	1241.2	1241.2	1518.9	1259.6	1655.4		1248.2	1096.5	
Last Update (HHMM UTC)	1710	1710	1710	1710	1710	1710	1710	1710		1710	1710	1710

This table was created at 02-26-2009 (MJD 54888) 17:10:26 UTC and will refresh every five minutes. Values are in units of nanoseconds.

Click on a time scale or country name to view a **one-way** GPS graph for the current day (GPS-NMI). Click on a number to view a **common-view** graph between two laboratories for the current day.

SIM Time Network reporting results

- Measurement results can be viewed using any Java-enabled web browser. Our web-based software does the following:
  - Plots the one-way GPS data (average of all satellites and tracks for each individual satellite) as recorded at each site relative to the local standard.
  - Plots the time and frequency difference between NMIs using the common-view method (common-view data are averaged across all satellites and are also shown for each individual satellite).
  - Calculates the Allan deviation and time deviation.
  - Makes 10 minute, 1 hour, and 1 day averages available in tabular form.
  - Up to 200 days of data can be retrieved at once. All old data remains available, nothing is ever deleted.
  - The time difference between any two laboratories can be viewed by all laboratories in the network. New results are available every 10 minutes.
  - Results can be processed as “classic” common-view or all-in-view.

SIM Time and Frequency Metrology Working Group

"Working to support time and frequency metrology throughout the Americas"

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Time and Frequency Groups

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- NIST
- NRC
- ONRJ

National Web Clocks (SIM region)

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- Canada
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- Mexico
- Panama
- United States

National Web Clocks (outside SIM)

- China
- Germany
- Japan
- Singapore

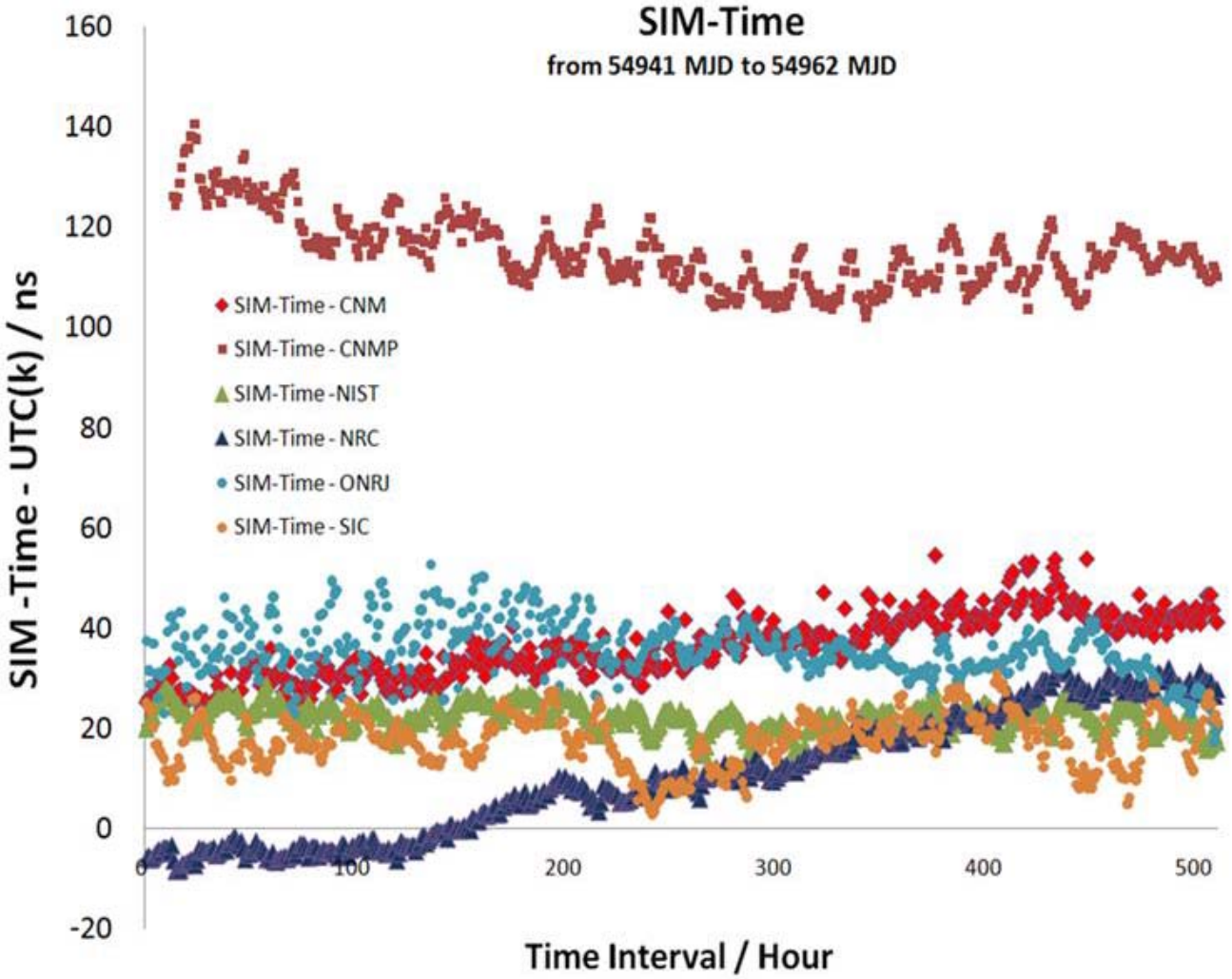
Welcome

This site contains files and information related to the Time and Frequency Working Group of the Sistema Interamericano de Metrologia. It is designed so that participating laboratories can share information and view the results of interlaboratory comparisons.

tf.nist.gov/sim

SIM Time scale

An averaged time scale available in real time trhough the SIM Time Network



Benefits to the SIM region

- Improved time coordination.
  - The CENAM, NIST, NRC, and ONRJ time scales are now nearly always within ±50 ns of each other.
- Better time standards are being maintained at many of the SIM labs.
- Increased awareness of the importance of time and frequency.
  - SIM labs are introducing new calibration services and improving existing services to better support local industry. New time services are also being introduced (NTP servers, web clocks, etc.).
- Improved status for NMIs.
  - Companies in SIM countries are likely to use their local NMI as a source of traceable frequency measurements.
- A more visible official timekeeper.
  - Some SIM labs are now trying to become the official timekeepers in their respective countries.

INTN es el nuevo encargado de fijar el horario oficial

El Instituto Nacional de Tecnología y Normalización (INTN) será desde los próximos días, el encargado de establecer la hora oficial en el territorio nacional.

Para el efecto, esta institución recibió un sistema de medición de tiempo desarrollado por especialistas del Grupo de Trabajo y Frecuencia (Ty FWG) del Sistema Interamericano de Metrología (SIM), que unifica la hora de más de 30 países.

El sistema consta de un reloj de rubidio que trabaja a base de nanosegundos (Un nanosegundo es la milmillonésima parte de un segundo).

BENEFICIOS. Según el ingeniero Óscar Salazar Yaryes, director de INTN, con este sistema existe gran precisión y esto beneficia a Paraguay.

"Hoy día, nuestro país integrado al mundo, requiere transferencia precisa de datos, ya que todo se maneja a nivel satelital, y por un segundo, un país puede quedar fuera de una subasta o de una transacción económica", explicó el director.

Gracias a este sistema, Paraguay se integra a los países que tienen un moderno sistema de horario. Ni São Paulo, de Brasil, cuenta con un sistema similar, según el ingeniero Salazar.

Por su parte, Eduardo Carlos López, físico mexicano enviado para instalar el equipo, manifestó que el sistema podrá unificar sus datos con otras sedes de investigación, que se encuentran en Canadá, en Estados Unidos, o en alguna de las 34 naciones, miembros del SIM. La información se actualiza cada diez minutos.

Este sistema de medición fue adquirido gracias a la ayuda del Sistema Interamericano de Metrología (SIM), y debe mantenerse alejado del polvo, así como debe evitar las temperaturas extremas, tanto de calor como de frío.

Además el ININ, habilitará un portal web, para que los interesados en saber la hora exacta, puedan recurrir a esta página.

"Se atrasan los relojes"

Anteriormente, la Armada Nacional era la encargada de fijar la hora oficial.

Según el oficial mayor Héctor Franco, la Armada Nacional se basa en un patrón del meridiano de Greenwich, para establecer la hora oficial.

"Nosotros restamos tres horas de la hora oficial de Greenwich para establecer la hora paraguaya", explicó.

Sin embargo, el militar expresó que ellos copian los datos del patrón de Greenwich, a un reloj digital, y allí surgen las diferencias.

"Nuestro reloj digital se atrasa unos segundos, luego de cada tres días, por eso tenemos que calibrarlo constantemente", reveló.

Franco comentó además que lleva en la Armada más de 19 años, y el reloj digital tuvo que ser reparado en varias ocasiones, pero aún así, él confía en este método de fijar la hora oficial.

RENE GONZÁLEZ

Tecnología. Carlos López, especialista mexicano, realiza los últimos ajustes al reloj de rubidio.

Conclusions

1. The SIM Time Network is intended to reinforce the metrology program in the Americas.

2. It is our intention to support SIM NMIs in order to conribute with data to the BIPM for the generation of the TAI and UTC.

3. We will continue with the effort to expand the SIM Time Network until include the majority of the SIM NMI members.

4. It is our intention to generate a real time scale (SIM Time scale) using measurements results produced by the SIM Time Network.