The Official Time of Peru

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***Abstract* — This paper describes the capabilities of the Time and Frequency Laboratory of INACAL and its methods used to obtain, provide, and disseminate the Official Time of the Republic of Peru with required accuracy and with traceability to the Coordinated Universal Time (UTC).**

***Index Terms* — time, frequency, official time, traceability.**

I. Introduction

Through Law N° 30224 [1], in 2014, INACAL was created and through of Supreme Decree N° 004-2015-PRODUCE [2], in 2015, the functions of INACAL were indicated for it to subsequently start its functions as a new institution in June of that same year. This Supreme Decree indicates that one of the functions of the INACAL's Directorate of Metrology is to *Maintain, Coordinate and Disseminate the Official Time of the Republic of Peru*. Thus, since 2015, INACAL is the institution responsible for the realization and distribution of the Official Time in the nation of Peru.

II. The Official Time of the Republic of Peru

The second (s) is the time unit of the International System (SI) and is defined based on the resonance frequency of the cesium atom 133 (9 192 631 770 Hz). The Official Time of the Republic of Peru is provided by INACAL through the National Time Standard [3] of the INACAL's Directorate of Metrology, which reproduces the second through the output signals of 1 pps (pulse per second) of a Symmetricom 5071A Cesium Oscillator. This 1 pps signal is used to synchronize a Meinberg M300 Network Time Protocol (NTP) Server, disabling the GPS that it uses to obtain a Local Time, in order to start generating from this Local Time, at an arbitrary time, the Peruvian National Time. The time signal that is obtained from the NTP Server is sent to a primary server to allow INACAL to disseminate the Official Time of the Republic of Peru via the public Internet. By accessing the INACAL website, Peruvian citizens and companies can visit the link *Hora Oficial del Peru* (Official Time of Peru), synchronize their watches or servers with the Official Time provided by INACAL (free of charge). This service is currently being provided to various users in the country (such as the Navy of Peru, telecommunications companies, broadcasting facilities, and banks, among others). Figure 1 shows a photo of the National Time Standard of the INACAL's Directorate of Metrology.

Fig. 1. National Time Standard of the INACAL's Directorate of Metrology (formerly known as SNM-INDECOPI).

III. Traceability of the Time and Frequency Laboratory of INACAL

In the Time and Frequency Laboratory of the INACAL's Directorate of Metrology, 1 pps and 5 MHz signals, provided by our Symmetricom 5071A Cesium Oscillator, are distributed. Through the TAI-1 Time Transfer Receiver, INACAL sends information about these signals to the BIPM to contribute to Coordinated Universal Time (UTC). The BIPM publishes monthly on its website *Circular T* [4], which contains the time differences between UTC and local realizations of UTC maintained by National Metrology Institutes (NMIs). In this publication, INACAL is identified as INCP (Lima), and the time differences UTC - UTC(INCP) is reported at five-day intervals. This measurement allows INACAL to establish traceability in time to the International System of Units (SI) via UTC. The UTC(INCP) time scale is also a reference in the region of the Inter-American Metrology System (SIM). Here, through the SIM Common-View Time and Frequency Measurement System, INACAL contributes to the maintenance and creation of the *SIM Time Network* [5], which is a network of continuous comparisons of standard oscillators of SIM countries. Through this network also is possible to observe the time difference in nanoseconds (ns) of our standard with respect to recognized institutes such as NIST (USA), CENAM (Mexico) or NRC (Canada). This tool allows us to observe the behavior in real-time of the INACAL standard, and we can use this information to make adjustments in time and/or frequency when necessary. Figure 2 shows a 40-day comparison of the INACAL standard with respect to UTC, where the time difference ranges from about 15 ns to

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about 60 ns. For this period the INACAL standard has a rate of change of about 1 ns per day, representing a frequency offset of about 1×10^{-14}.

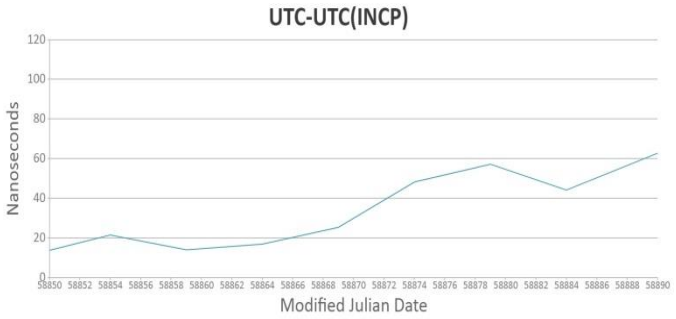

Fig. 2. Comparison during 40 days of the standard oscillator of the Time and Frequency Laboratory of INACAL with respect to UTC.

INACAL also participates in the SIM NTP Server Comparisons [6], which is a network of continuous comparisons of various NTP servers of SIM countries. This network allows us to observe the time difference in milliseconds (ms) of our NTP server by comparing it to servers in other countries. In the case that this difference exceeds the value of 50 ms, this difference will be shown in red color as an alert signal for the NMIs to take the actions of the case. The NTP client requests used for these measurements originate from NIST in the United States, so this tool allows us to observe the behavior of the INACAL NTP server, when accessed by an external user outside of Peru. Figure 3 shows a 30-day comparison of the INACAL NTP server with respect to NIST, where time difference ranges from about -20 ms to about 20 ms, with an average value of about 0 ms.

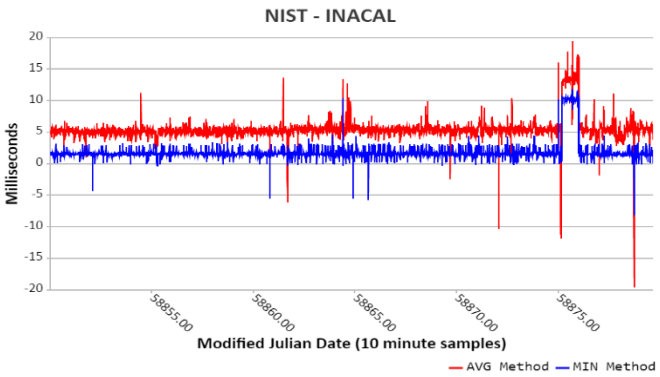

Fig. 3. Comparison during 30 days of the NTP Server of the Time and Frequency Laboratory of INACAL with respect to NIST.

Finally with traceability to the UTC, the 1 pps signal from our standard oscillator is used to obtain and maintain the Official Time of Peru, while the 5 MHz signal is used to improve the time base of the laboratory equipment and offer different calibration services with international recognition and traceability to the SI via UTC, which can be located on the BIPM website. Figure 4 shows the traceability chain of the Time and Frequency Laboratory of INACAL.

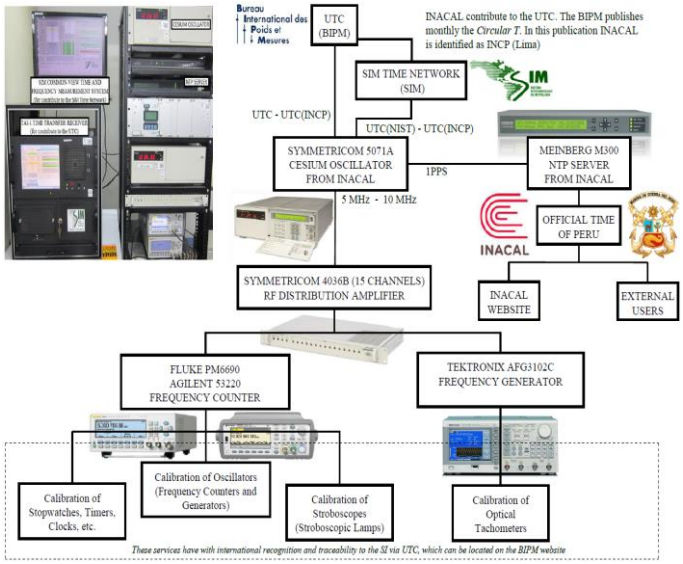

Fig. 4. Traceability chain of the Time and Frequency Laboratory of INACAL.

IV. Conclusion

This paper shows that the Time and Frequency Laboratory of INACAL has the necessary equipment to obtain, provide, and disseminate the Official Time of the Republic of Peru with traceability to the SI via UTC.

Acknowledgement

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