FREQUENCY AND TIMING SYSTEM AT THE NATIONAL INSTITUTE FOR STANDARDS (NIS)

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ABSTRACT

The National Institute for Standards (NIS), is charged with the responsibility of establishing and maintaining the national standards of physical measurements and providing means for their effective utilization. Time and frequency division of Egypt makes the International comparison to relate NIS frequency standard to UTC.

Traceable frequency calibrations to NIS of standard clocks kept in other Egyptian scientific organizations, military and industrial laboratories are provided by means of daily television measurements and common-view monitoring of Loran-C signals by the user and by NIS.

This paper describes the Frequency and Tinming system used at the NIS and the methods of comparing NIS frequency standard with UTC.

Diagrams and specifications of today's system and plans for future work will be presented.

1. INTRODUCTION:

Time and Frequency Laboratory of Egypt was established in 1967. In that year the National Institute for standards NIS took delivery of its first commercial cesium standard. From then on, it has been developing step by step and its performance level has also progressed gradually. International comparisons are continuously carried out to relate NIS frequency standard to UTC since 1967. Reception of VLF transmissions from GBR (16KHz), Rugby, England was used for phase comparison with good results [1-2].

In March 1982, NIS contracted with AID and National Institute of Standards and Technology NIST, Boulder to improve the time and frequency measurement system. Upon the delivery of receivers, reception of Omega transmissions and LORAN-C navigation signals have been started. The results of continuous phase comparison between Monrovia, Liberia and the NIS frequency standard using the Omega transmitter (12 KHz) a distance of 5100 km were given in Ref [3]. A study of the receiving conditions using the Loran-C transmissions of the Mediterranean chain was made at NIS to determine the accuracy and reliability of time difference measurements [4].

2. PRESENT STATUS

2.1. Reference clock system:

The reference clock system currently being used at the NIS consists of the Cesium Beam frequency standard, a secondary Rubidium vapour frequency standard and high quality crystals. The primary frequency standard for the timing system is the HP model 5061A (opt. 004) Cesium beam oscillator. The outputs of the frequency standard are used as reference signals to drive the LORAN-C receivers and other equipment via the distribution amplifier. Battery operated power supply is used to provide uninter-ruptible power to the standard in the event of a power failure.

2.2. Measurement Facility:

The receiving system comprises two VLF receivers, three automatic Mieco receivers and two 2000 C LORAN-C timing receivers. The data acquisition system is based at present on a personal computer with time-of-day clock, printer and disc store the data system was provided from NIST, Boulder [5]. A functional diagram of the equipment used for the realization of UTC (NIS) is given in Fig.1 and the photo of the timing system is shown in Fig.2. UTC (NIS) is connected permanently to the start terminal of each channel of the 4 channel time interval counter.

Each station is received by means of two types of the Loran-C receivers and the receiver output is connected to the stop terminal. Each measurement is the mean of 400 time difference readings. The computed results, together with a time tag are printed each hour on a floppy disc for permanent storage and subsequent analysis.

3. DATA COLLECTION AND PROCESSING

For many years, Loran-C 7990 Y from kargabarun, Turkey in the Mediterranean sea chain has been the mainstay of the time link from NIS to the Bureau International de l'Heure (BIH). Regular measurements are made on the automated measurement facility. The time interval counter makes the time interval measurements and transfers them to the computer for storage on disc. When all the necessary data is stored, time position analysis is accomplished by using the data analysis system.

The data collected at NIS at the last 2 months referencing the NIS to 7990 Y is a good example of problems arising in the received data. The plot shown in Figure 3 shows that around October 23 the data had a sudden jump of about 6 us, then continimng drifting at the same rate. Figure 4 gives the data after removing phase jumps.

In the meantime a continuous check on the accuracy of the 8990 X station clock is carried out [6]. Reception of this signal should be of great value to users in our area and to south Asia because of much storter distance, 408 km from NIS. Figure 5 gives the relative frequency of the 8990 X station clock.

An example of measurements made over a number of days is shown in Figure 6. The values shown represent the daily accumulated phase shift. The phase shift is measured by comparing the output of a Loran receiver to the cs(NIS) for a period of 24 hours.

4. TIME AND FREQUENCY CALIBRATION AND DISSEMINATION

The dissemination of the time/frequency units within the country is realized by two techniques.

1. Passive TV synchronization technique: Accuracies of 100 us in time and $1x10^{-9}$ in frequency can be achieved.
2. LORAN-C common view monitoring: Frequency calibration requirements at the level of 1 part in 10^{12} can be achieved using this service.

Calibrations are provided for precision oscillators and reports giving the relative frequency versus cs(NIS) are supplied.

Periodically, the NIS holds workshops intended for engineers and lab technicions involved in the application of time and frequency measurements.

5. FURURE PLANS

In the near future the developments in the time and Frequency standards field will focus on the development of accurate time comparison techniques via satellites (e.g. GPS [7], two way communication satellites).

The future goals of the division include also the use of Arabsat as a vehicle for time and Frequency dissemination . This project will help the communications industry to meet some of the timing requirements in digital communication systems.

For all the activities planned and mentioned above, anyone interested in cooperating will be welcomed. The laboratory also welcomes any proposals from other laboratories, for collaboration in this field.

6. CONCLUSION

Current activities in the PTTI area at NIS Egypt has been presented. NIS maintains a cesium beam reference standard, continuously compared with UTC using Loran C signals. NIS clock data is reported. The relative frequency of the clock station 8990 X is given.

ACKNOWLEDGEMENT

Special thanks to Mr George Kamas of the NIST , without whose continued support and encouragement this work should not be possible.

References:

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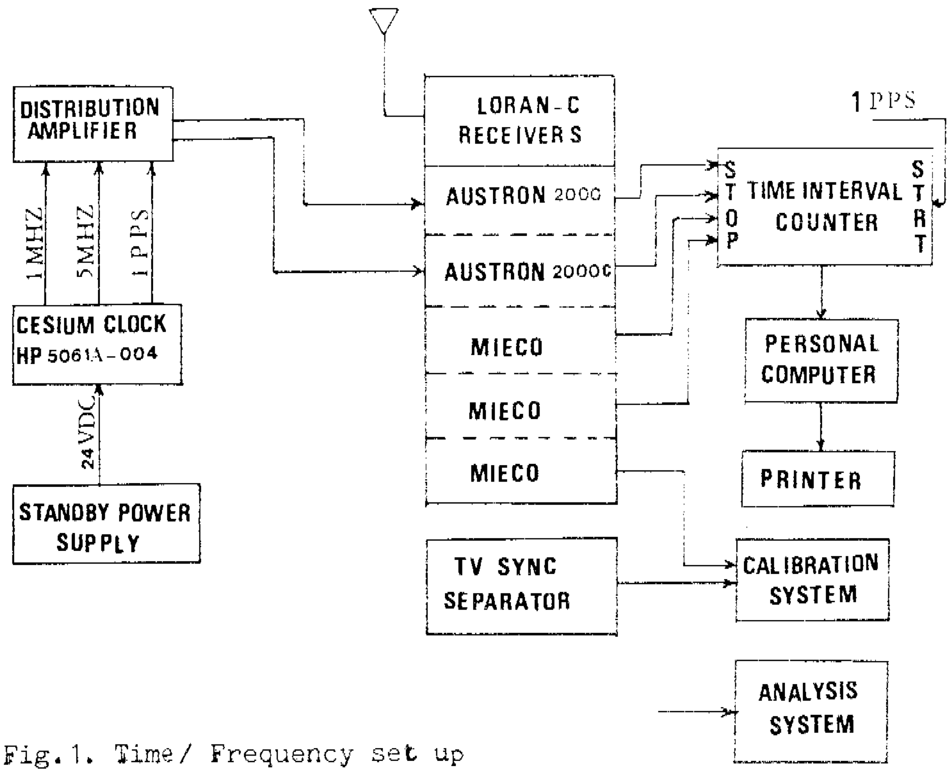


Fig. 1. Time/ Frequency set up

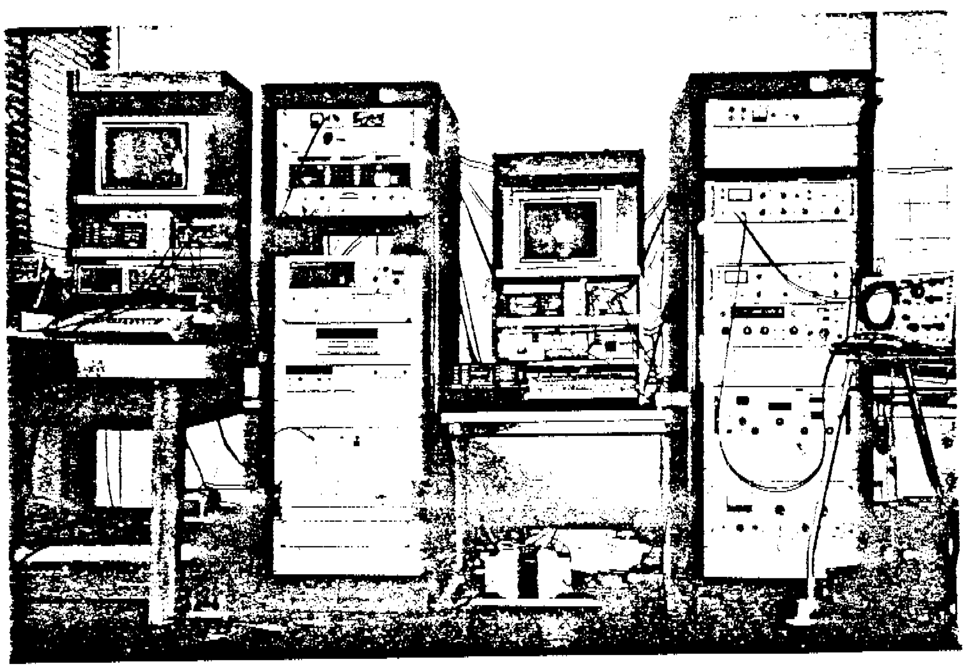


Fig.2. Part of the Time and Frequency Laboratory.

Fig.3. CS VS LORAN 7990Y (M)

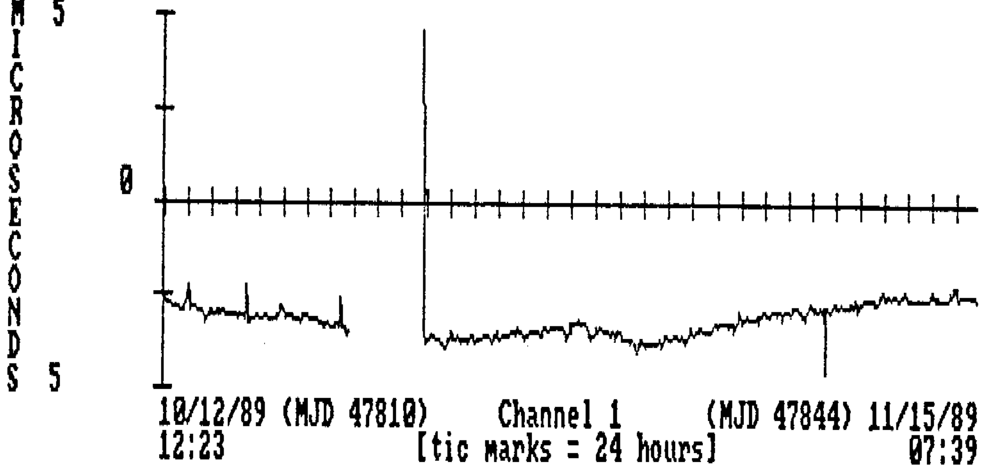
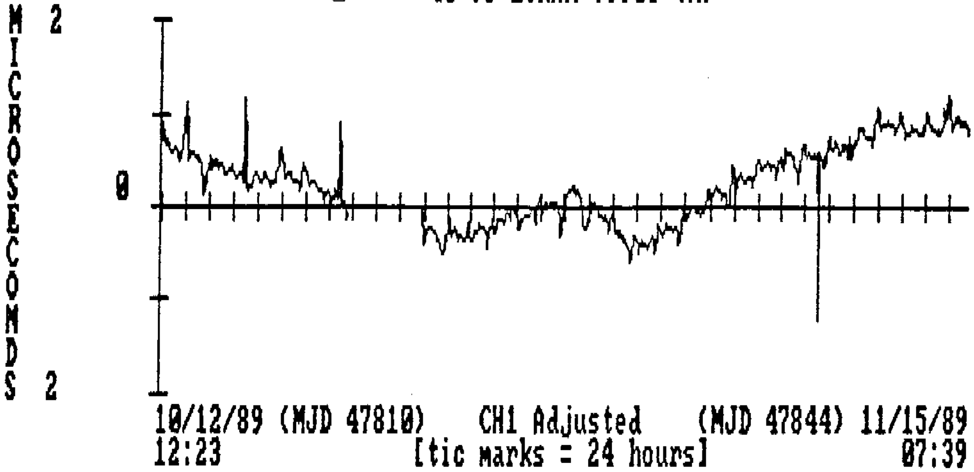
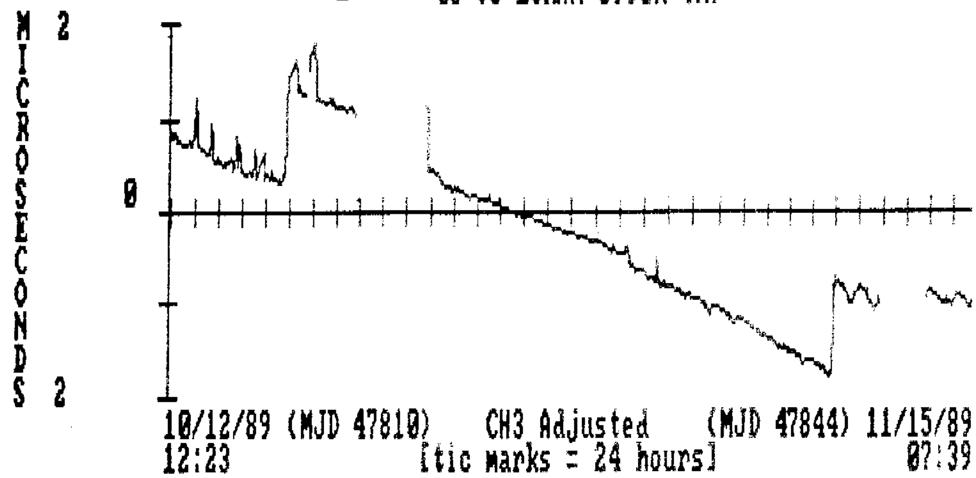


Fig.4. CS VS LORAN 7990Y (M)



The relative frequency is: +1.52E-13 Data Points 530

Fig.5. CS VS LORAN 8990X (M)



The relative frequency is: -9.20E-13	Data Points 506

Fig.6.

DATE			UTC(NIS)-LORAN PHASE (µS)	
1989		MJD	LORAN C Turkey (7990-Y)	LORAN C Homyd (8990-X)
Oct	31	47830	+0.23	+0.20
Nov.	1	47831	-0.11	+0.16
	2	47832	-0.23	+0.12
	3	47833	-0.18	+0.12
	4	47834	-0.21	+0.12
	5	47835	-0.05	+0.20
	6	47836	-0.10	+0.16
	7	47837	-0.12	+0.10
	8	47838	-0.10	-0.84
	9	47839	+0.02	-
	10	47840	-0.36	-

QUESTIONS AND ANSWERS

GERNOT WINKLER, USNO: I wonder if there is any possibility of suggesting to the authorities which operate chain 8990 to put it more exactly on frequency, because your numbers indicate a frequency offset of somewhere around 1×10^{-11}. Or am I mistaken?

MS SAMUEL: They don't make an attempt to keep it on frequency.

MR. WINKLER: Then I suggest that they adjust it regularly as is done in the U.S. to keep it very close to the time and frequency of a national reference. In that case, the users could obtain the services directly, for example, frequency calibration.

MS SAMUEL: They don't want to negotiate with Egypt.