LITHUANIAN NATIONAL TIME AND FREQUENCY STANDARD

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Abstract

The Lithuanian National Time and Frequency Standard Laboratory is responsible for maintenance and dissemination of the national time scale UTC (LT), time and frequency units. Since June 2001, we have been contributing to TAI. The Laboratory is equipped with two HP5071A cesium atomic clocks (one with a high-performance Cs tube) and two TTS-2 multi-channel GPS receivers based on Motorola VP Oncore GPS processors. One of the GPS receivers is equipped with thermo-stabilized GPS antenna. For the dissemination of the Lithuanian Time Scale UTC (LT), the NTP server Datum 2001 is used. In this paper, the main metrological characteristics and technical possibilities of the National Time and Frequency Standards are presented.

INTRODUCTION

On 11 March 1990, when Lithuania's independence was restored, a new phase of development — the process of integration into transatlantic organizations — started in our country. This meant a beginning of reorganization of the Lithuanian system of metrology as well. In 1993-1995, a profound analysis of metrological needs of economic entities and scientific institutions was made. After the results were summarized, it was decided to establish a decentralized Lithuanian National Metrology Institute (NMI). The NIM should include laboratories of primary standards, which would be located at various scientific institutes. It was also decided to establish the following national standards:

- Primary standards of time and frequency – at the Semiconductor Physics Institute (SPI), Vilnius;
- Primary standard of temperature – at the Semiconductor Physics Institute, Vilnius;
- Primary standards of voltage and resistance – at the Semiconductor Physics Institute, Vilnius;
- Standard of gauge blocks – Vilnius Metrology Center;
- Standards of the air (gas) flow and volume units - Lithuanian Energy Institute, Kaunas.

On 5 April 2002, the Government of the Republic of Lithuania approved the Time and Frequency Standard Laboratory of the Semiconductor Physics Institute as the keeper of the National Time and Frequency Standards. Since May 2001, the National Laboratory of Time and Frequency Standards participates in the process of forming the International Atomic Time Scale (TAI).

LABORATORY DESCRIPTION

The Lithuanian National Laboratory of Time and Frequency Standards is a unit within the Metrology Department of the Semiconductor Physics Institute. The Laboratory occupies three rooms with a total area of 150 m^2. The rooms in which the cesium atomic clocks and equipment for comparison and distribution of time signals operate are electrically screened. A temperature of 21±1ºC is maintained in these rooms by air conditioning and control systems.

A scheme of links between the laboratory equipment is provided in Figure 1. The most important equipment in the laboratory are the cesium nuclear clocks HP5071A and AGILENT5071A. The AGILENT5071A atomic clock, which has operated in our laboratory since April of 2003, is equipped with a high-performance Cs tube. We use two TTS-2 Time Transfer Systems with Motorola VP Oncore GPS multichannel receivers for comparing time signals. The systems were produced and calibrated by the Astrogeodynamical Observatory of the Space Research Center, Polish Academy of Sciences. A platform of GPS antennas has been installed on the roof of the institute building and is securely joined with the construction elements of the building. The coordinates of the sockets of GPS antennas were measured in the ITRF97 system of coordinates with a 0.5 cm uncertainty. The measurement was carried out by the experts of the Institute of Geodesy of the Vilnius Gediminas Technical University.

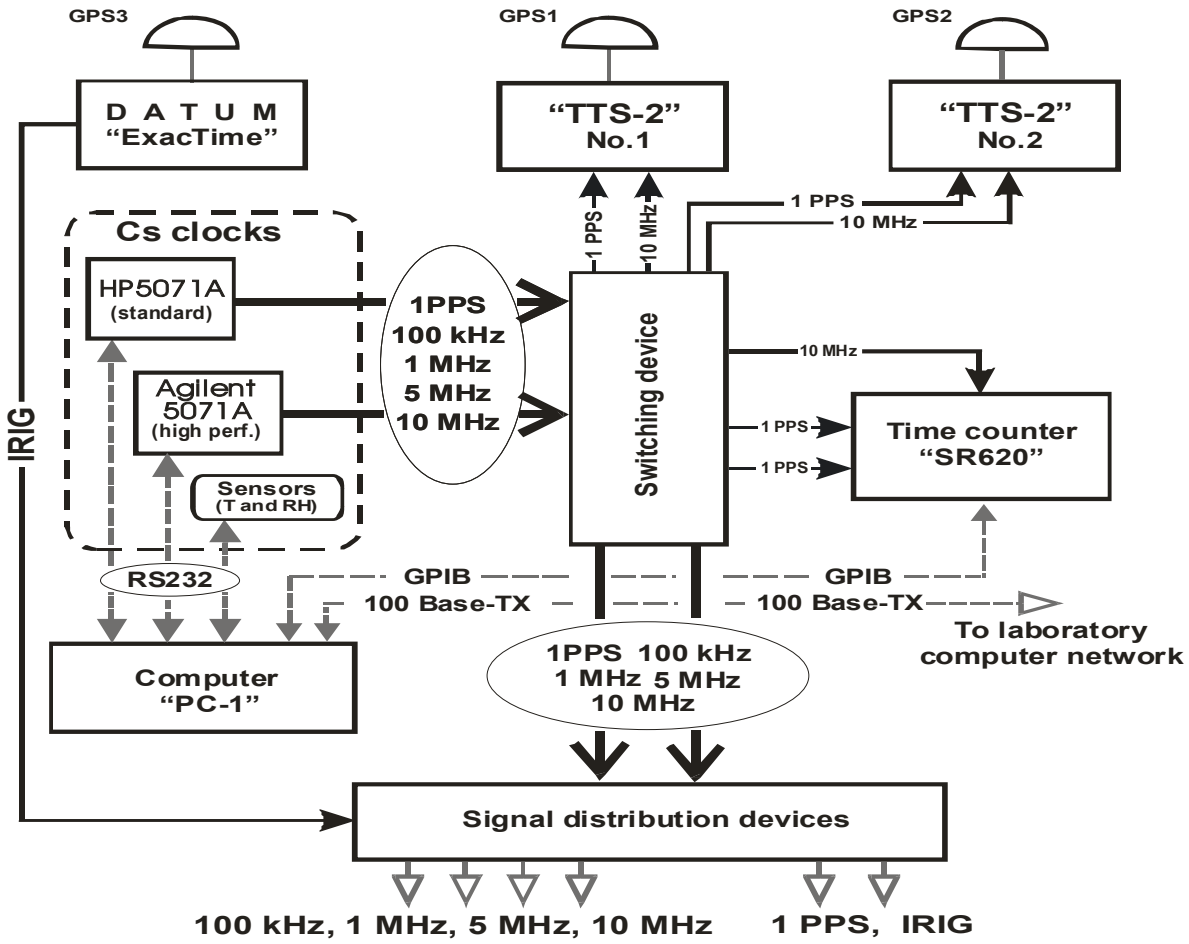

Figure 1. Schematic representation of laboratory equipment.

At the present time, the main HP5071A atomic clock is connected to the first TTS-2 time transfer system. The data are collected by the microprocessor of the first TTS-2 time transfer system using the common view method and sent to the Time Division of BIPM. Figure 2 reveals the weight factor of the main LT clock from the time it joined in the formation of TAI until now. The second TTS-2 time transfer system was installed in May of 2003. It has been supplied with a thermo-stabilized GPS antenna.

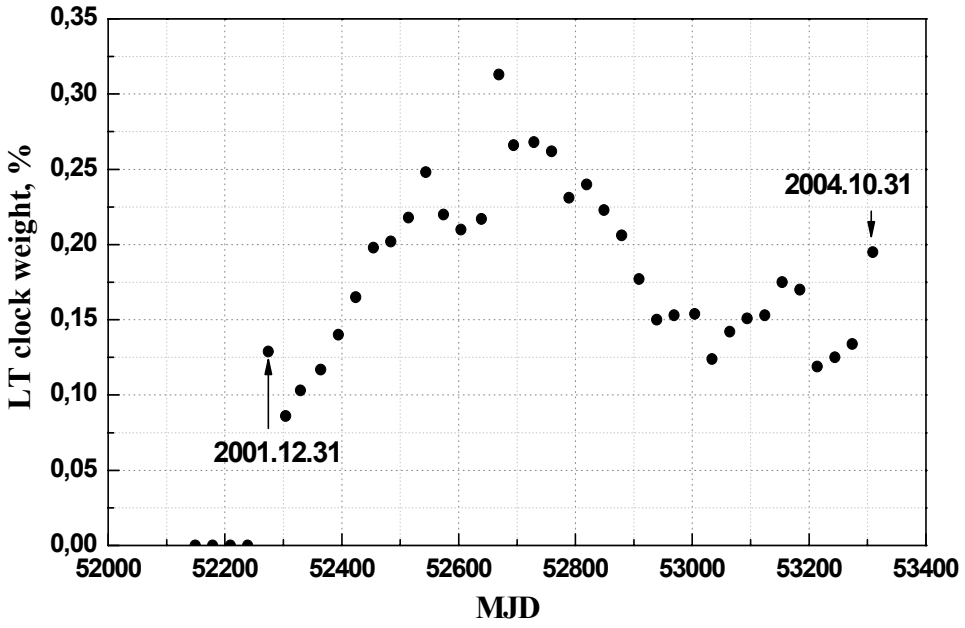

Figure 2. LT clock weights (*www.bipm.org*).

Intrinsic technical parameters of atomic clocks as well as environmental condition (temperature T and relative humidity RH) are registered by the computer PC1. The layout of the Laboratory's computer network is given in Figure 3.

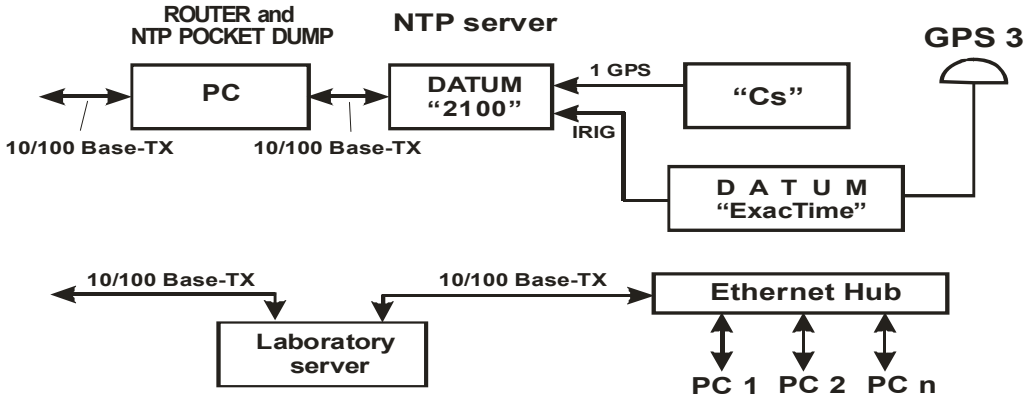

Figure 3. Computer network layout.

In February of 2003, a quality system according to ISO/IEC 17025 was implemented by the Laboratory. In September of 2003, the implementation was recognized by the Quality Forum of EUROMET in Istanbul. The quality system is assessed annually by experts of European accreditation bodies.

TIME SERVICE

The Laboratory operates a TymServe 2100 NTP server manufactured by Datum, Inc. The server receives 1 second pulses (PPS) from a laboratory's atomic clock. Exact time signals generated by the Laboratory at the beginning of each hour are transmitted to Lithuanian Radio.

OTHER ACTIVITIES

COOPERATION

Besides participation in the activities of the Time Division of BIPM, the Lithuanian National Time and Frequency Laboratory cooperates with the Polish Central Office of Measures (GUM) in the formation of the independent atomic time scale TA (PL).

DISSEMINATION OF KNOWLEDGE

During qualification courses, lectures on different topics of the metrology of time and frequency are given to the technical personnel of calibration laboratories.

FUTURE PLANS

The Laboratory's plans in the near future include implementation of technologies for the generation and dissemination of an authorized electronic time stamp to promote the use of electronic signature in Lithuania. We plan to develop methods for the investigation of metrological characteristics of frequency sensors whose operation is based on surface acoustic waves.

ACKOWLEDGMENTS

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