DATABASE FOR TA (PL) AND UTC (PL)

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Abstract

Since the early years of this decade, the set of Polish metrology and science laboratories have been organized in a group for the local independent ensemble atomic timescale TA (PL). From the beginning, Lithuania (SPI) has participated in the calculations. This year, the laboratory in Latvia (LNMC) also joined our group. The number of standards which form our timescale have changed from 7 to about 15. In 2004, the National Institute of Telecommunications started a project to develop a Database for TA (PL) and UTC (PL). The goal was to reduce the time of waiting for results of comparisons of clocks which was necessary to control time and frequency. In the beginning, the time delay was about 1.5 months.

This document presents elements of the automated system developed to process the results of clock comparisons and to compute the ensemble timescale. First, it shows the general work flow scheme. The next part presents the ensemble timescale based on implemented algorithms (ALGOS, AT1) and useful functions built in to provide control over clocks. The last part contains a short description of functions planned for future development.

1 INTRODUCTION

Since 2001, the set of Polish metrology and science laboratories have been organized in a group for the local independent ensemble atomic timescale TA (PL). From the beginning, Lithuania (SPI) has participated in the calculations. This year (2008), the laboratory in Latvia (LNMC) also joined our group. The number of standards which form our timescale have changed from 7 to about 15. In 2004, the National Institute of Telecommunication started a project to develop a Database for TA (PL) and

UTC (PL). The goal was to reduce time of waiting for results of comparisons of clocks which was necessary to control time and frequency. In the beginning, the time delay was about 1.5 months.
The first goal was to test algorithms and run a free Database to compute ensembles in monthly periods. This task has been completed in test runs. Now we are starting the operational run. Next, we will try to shorten the period between computations to 1 week, and then to 1 day.

Currently, 17 clocks from 10 laboratories are participating in TA (PL):

- GUM - Central Office of Measures (Poland) - four standards
- AOS - Astronomical Observatory of Polish Academy of Science (Poland) - four standards
- SPI - Semiconductor Physics Institute (Lithuania) – two standards
- LNMC - Latvian National Metrology Center (Latvia)
- NIT - National Institute of Telecommunications (Poland) - two standards
- CBR and ZGO - laboratories of Polish Telecommunication operator - two standards
- ITR - Tele & Radio Research Institute (Poland)
- CWOM-B and CWOM-Z - metrological laboratories of Polish Army - two standards.

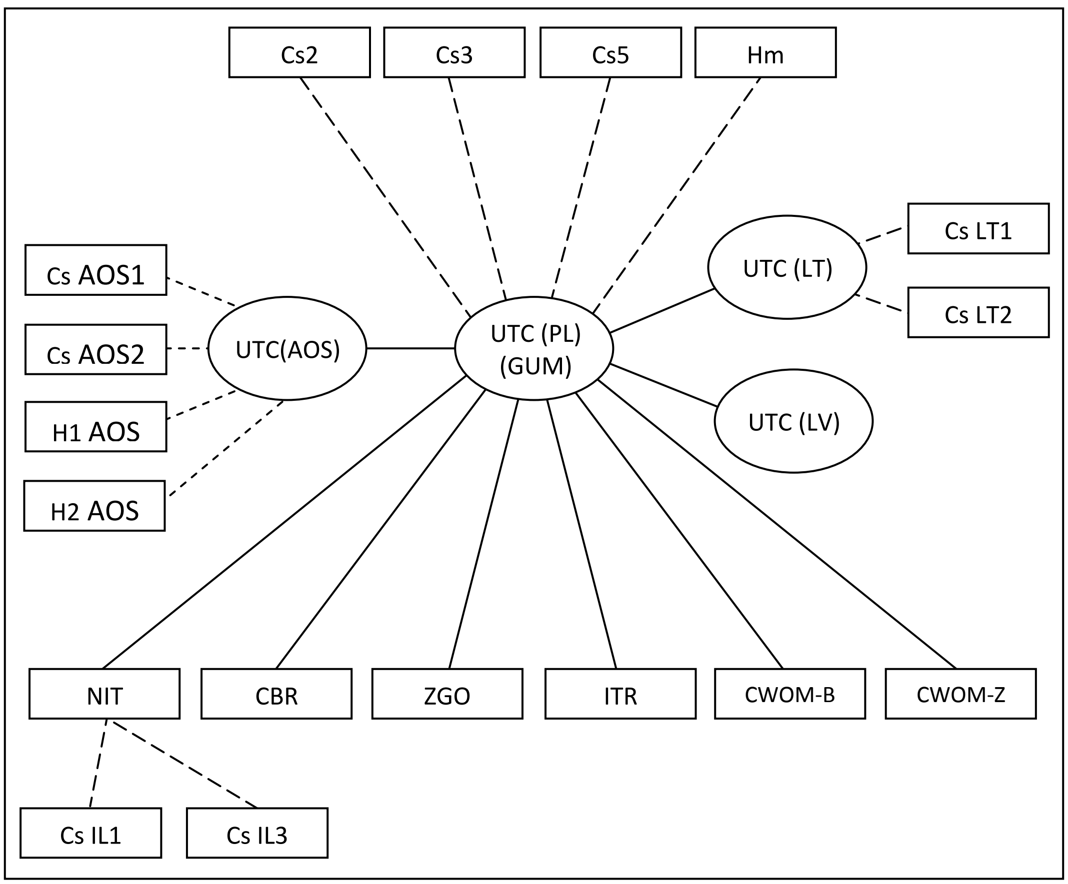

Figure 1. TA (PL) clock comparison scheme.

2 DATABASE ORGANIZATION

The Database is organized in three major subsystems. Each of them is responsible for other task:

- Data acquisition unit – managing of data files
- Calculation unit – calculation of clocks comparisons and timescale algorithms
- Result presentation unit – presenting demanded results.

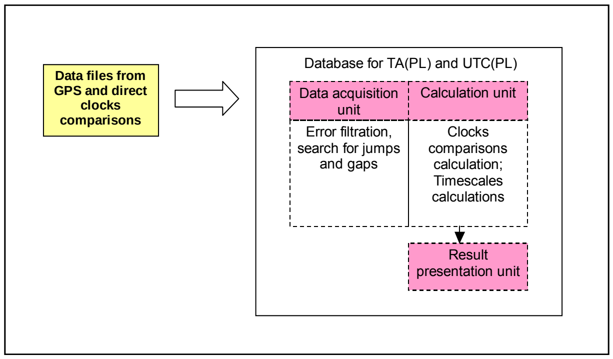

Figure 2. Database general workflow scheme.

The Database can handle four types of files:

- standard GPS/GLONASS data files – compatible with CGGTTS format
- direct clock-clock data comparison files
- correction files – with information about known phase and frequency steps
- complete comparison matrix of clocks to UTC (PL) in Excel format (for any period of time).

The Database allows delivery of comparison data in two main ways. Every laboratory can send data to the Database as a attachment in an e-mail or can put them into a remotely available directory and allow the Database to download it automatically by itself. It is also possible to load data by means of an administrator.

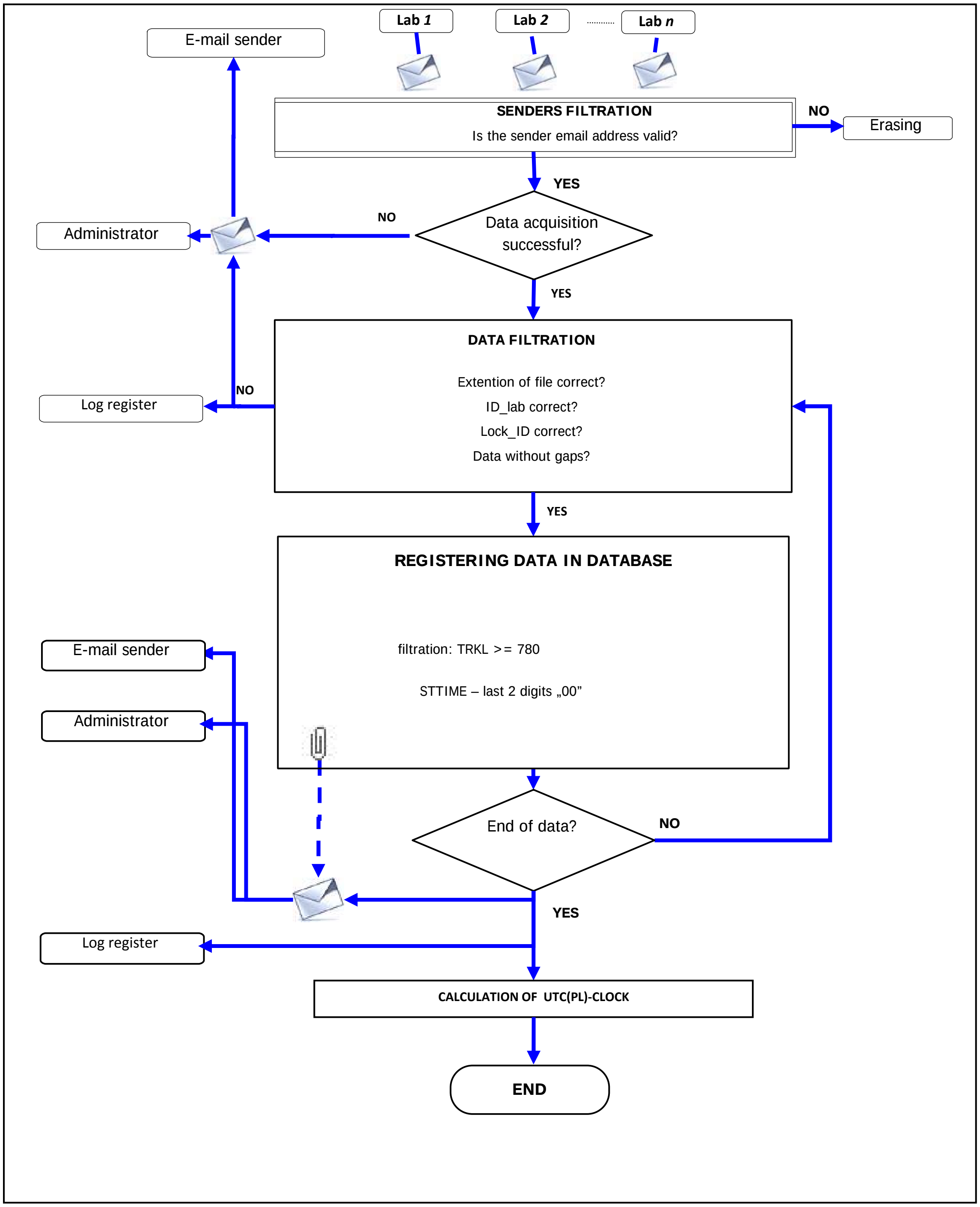

Figure 3. Data acquisition scheme.

3 DATABASE USER INTERFACE

The Database allows not only computation of implemented ensembles; it also provides many useful functions to control the behavior of clocks.

The Database allows the user:

- to log in after receiving a login name and password
- to compare clocks one to one
- to extract comparisons of any clock to UTC
- to extract results of any clock in any of the implemented algorithms
- to extract comparisons of any algorithm to UTC/TAI
- for advanced users, it also allows one to modify the initial parameters of test timescales and proceed with the calculation (this function is very useful to tune up algorithms)
- to calculate ADEV and TEDEV online for suitable data
- to estimate drift by using the Discrete Model function.

The Database also provides very useful services for users:

- information about the localization of clocks
- information about types of clocks
- information board to announce important declarations
- upload of many types of files to share with other users
- calendar with the possibility of calculating MJD data
- download of original clock comparison data files.

First, what the user sees after logging in is a main page of the interface of the Database. Here is the place to read or announce notices important for database work, such as clock regulations, time transfer delay parameter changes, etc. The right panel allows access to the information section, where the user can check the current status of clocks, including their locations. From the top menu of the page, the user can choose many tests to control his clock with respect to another clock or chosen timescale.

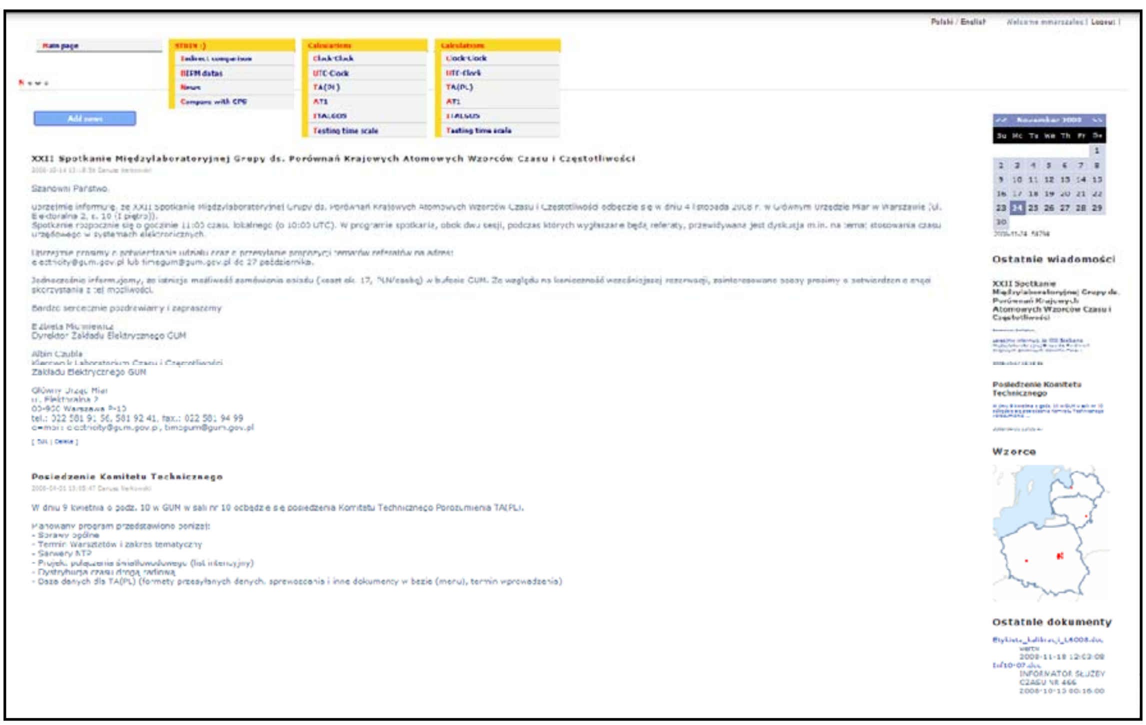

Figure 4. Main page layout.

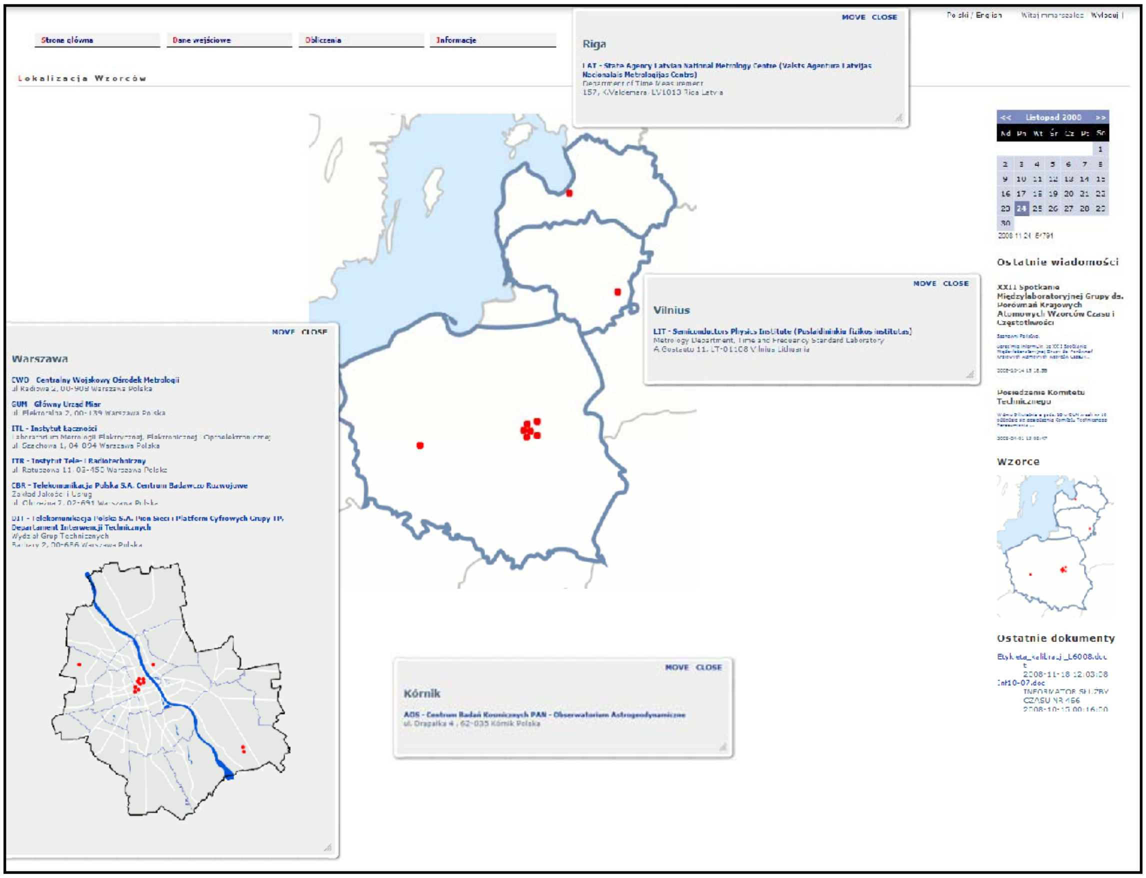

Figure 5. Clock localization.

This is an example of direct comparison between two clocks. The result of calculations can be analyzed by running a set of ADEV/TDEV or discrete model functions.

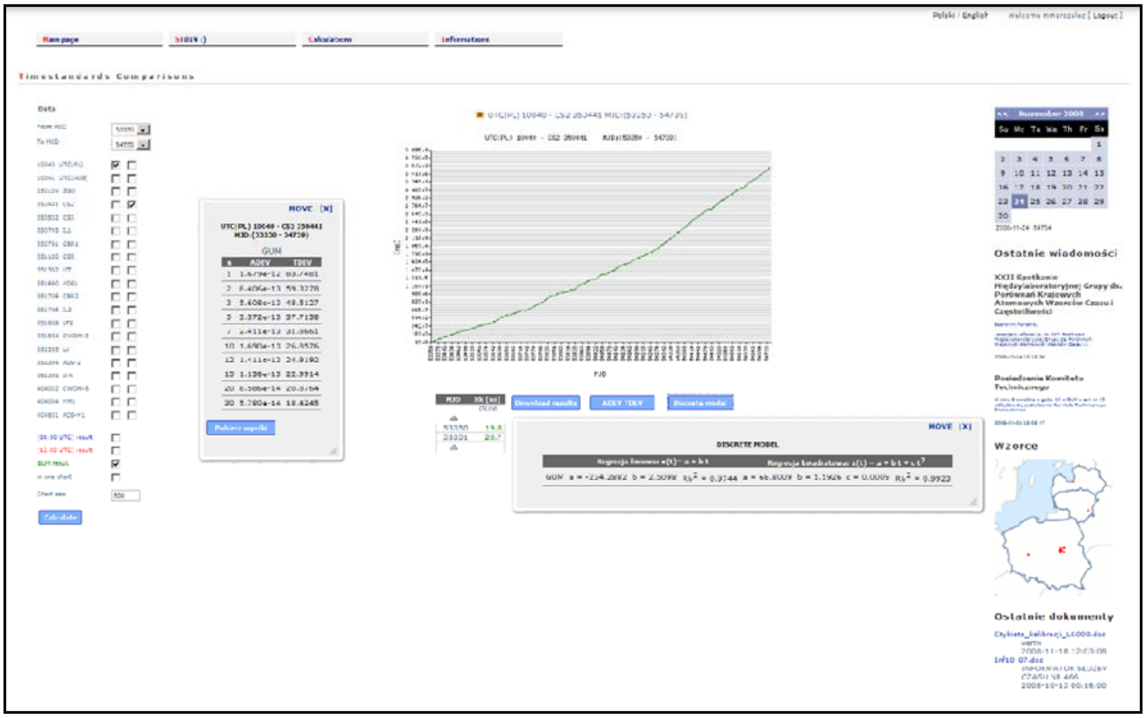

Figure 6. Clocks comparisons (clock-clock calculation).

Figures 7 and 8 present calculation sections of the ALGOS-based (simply Algorithm BIPM) and AT1 algorithms. The result of calculations can also be analyzed by running a set of ADEV/TDEV or discrete model functions.

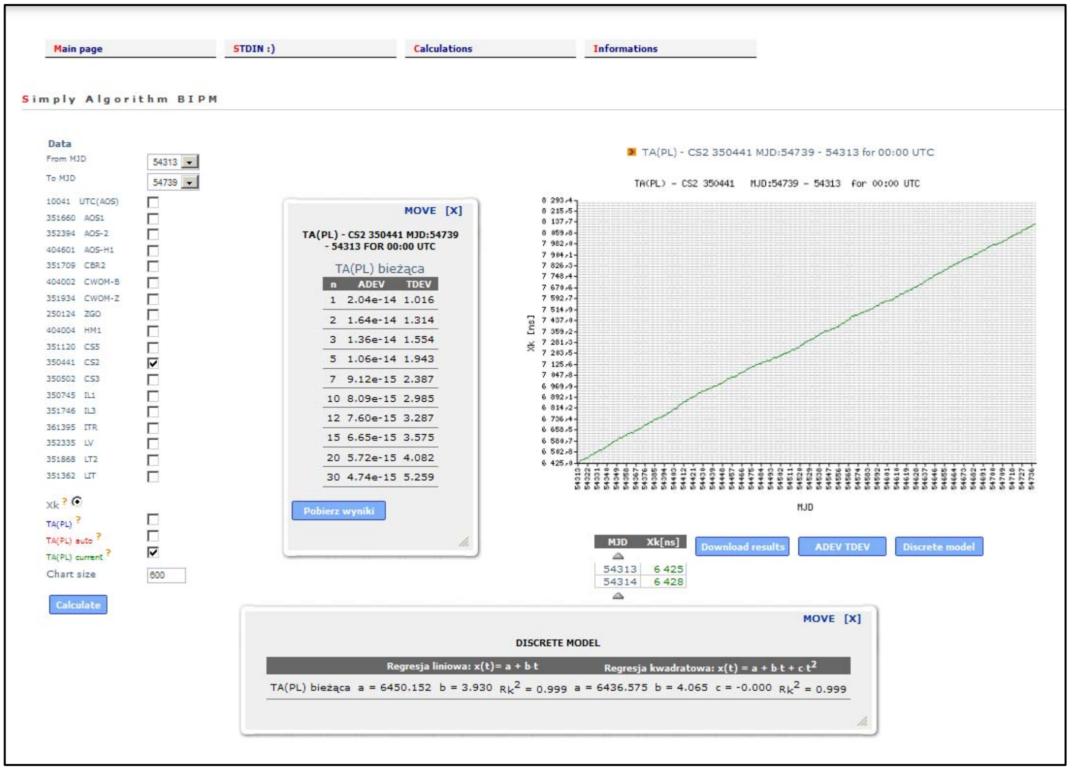

Figure 7. Calculation of the ALGOS-based algorithm.

Figure 8. Calculation of the AT1 algorithm.

4 STABILITY OF IMPLEMENTED ALGORITHMS

During the last stage of completing the project, a vast amount of test runs was done. Selected results are shown below. Figures 9 and 10 shows results of the ALGOS-based algorithm (which is now the official TA (PL) algorithm) compared to UTC.

Figures 11 and 12 present results of two versions of the AT1-based algorithm, basic and modified. During the process of implementation, many of modified versions of the algorithm were tested. After thorough analysis of results of all the modified algorithms, we are going to prepare individual paper on this subject.

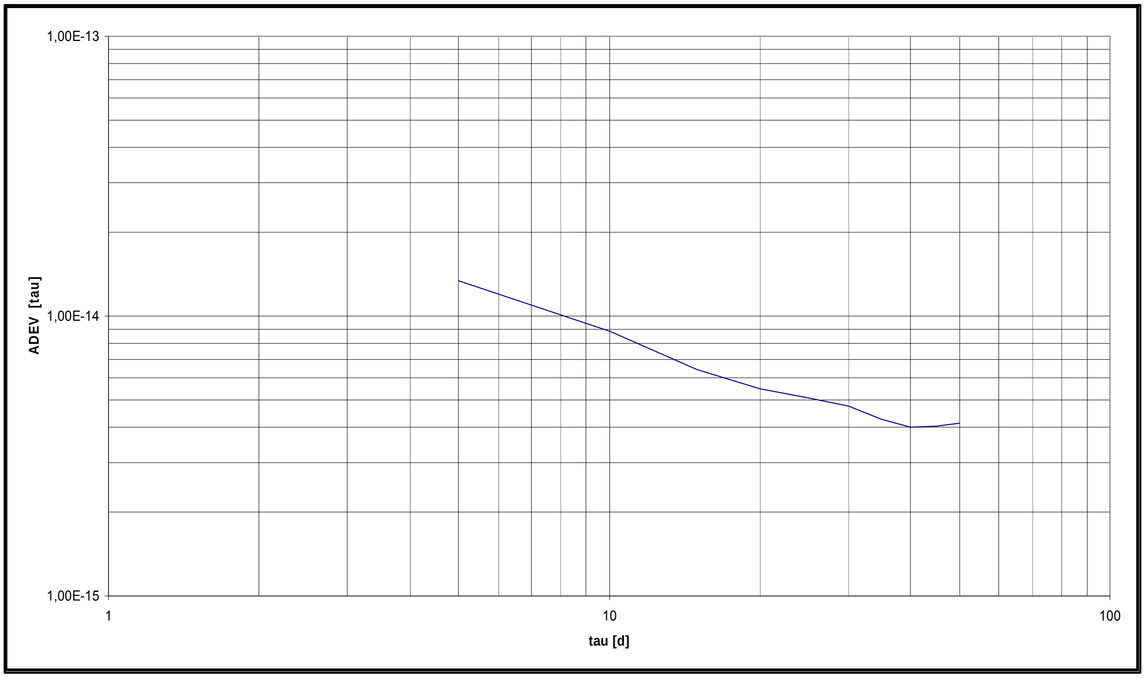

Figure 9. ADEV characteristics of the automatic TA (PL) time group scale with respect to UTC.

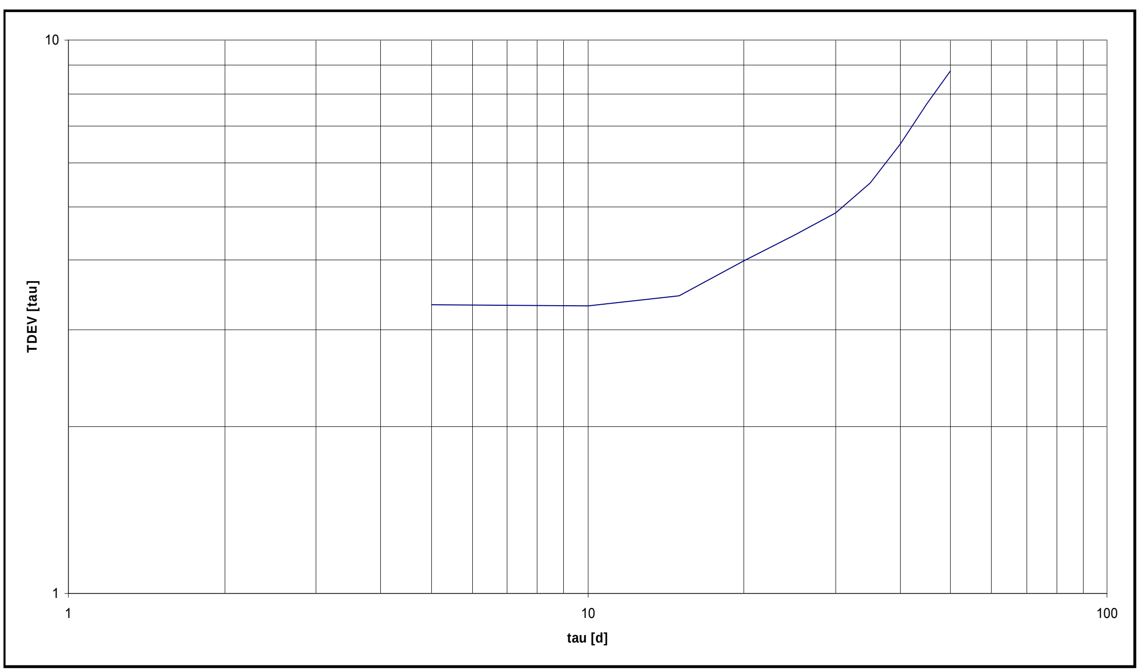

Figure 10. TDEV characteristics of the automatic TA (PL) time group scale with respect to UTC.

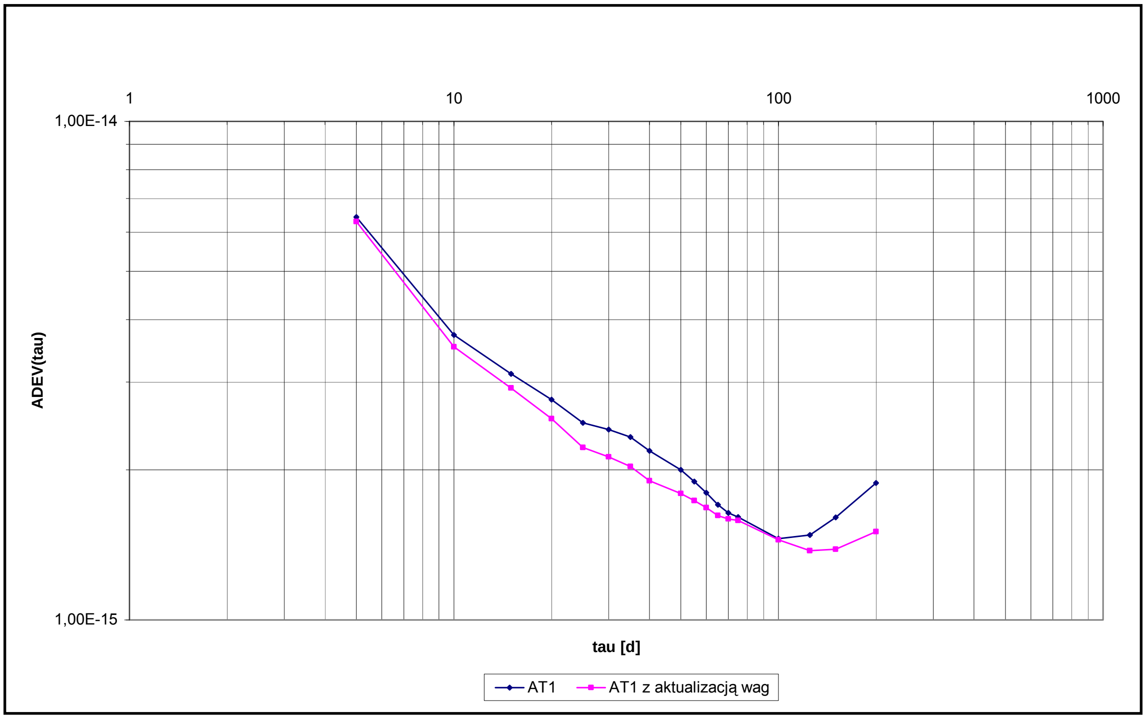

Figure 11. ADEV characteristics of the AT1 time group scales with respect to UTC.

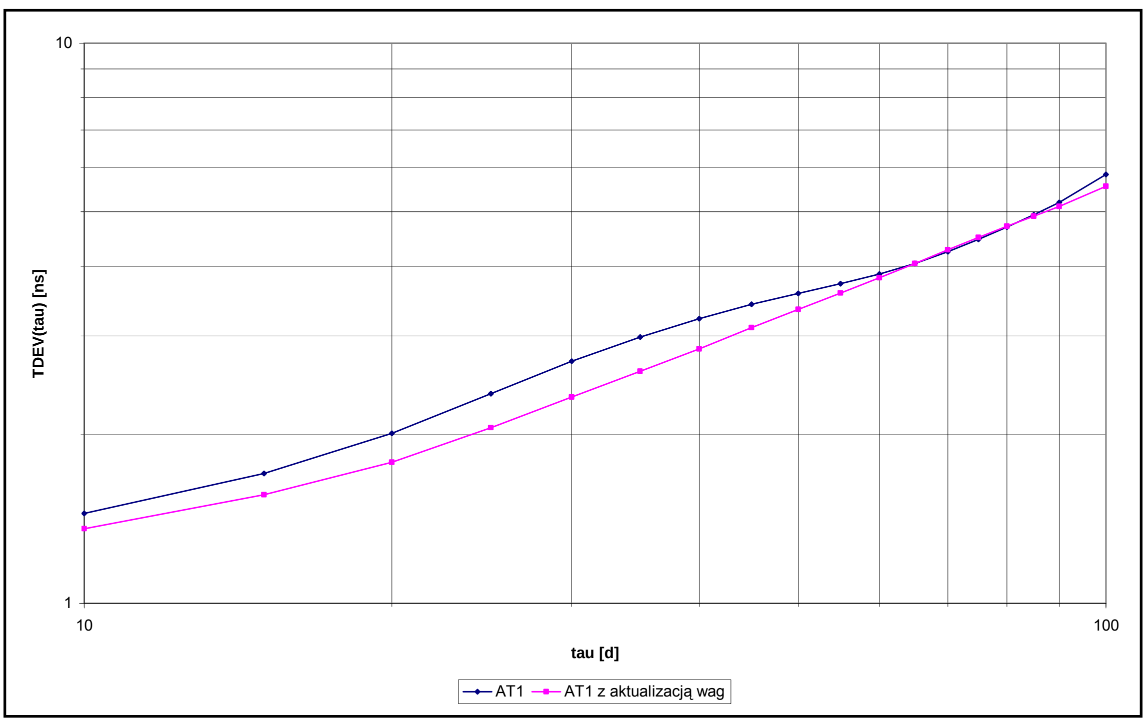

Figure 12. TDEV characteristics of AT1 time group scales with respect to UTC.

5 CONCLUSIONS AND FUTURE PLANS

During the time of developing the database, our time-team solved many problems and got the database operational, but still sometimes problems emerge form nowhere. The Database allows every user to control his clock in an easy way. There is no need to manually compare data to a clock or any timescale. Everything works automatically. Every result can be analyzed by implemented functions.

In 2007, we started new projects which in the future will allow implementing better algorithms (e.g., AT2) and will enable getting better results from presently used algorithms.

Our work is now concentrated on:

- fault detection problems (accidental phase or frequency shifts)
- advanced filtering of input data (Kalman and Vondrak filtering)
- building into the database an interface for automatic timescale steering.

We are still planning to develop and implement new functions into the Database. It should allow users to easily maintain their clocks and in effect to improve stability of TA (PL).

6 REFERENCES

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