

ELSTAB - electronically stabilized time and frequency distribution over optical fiber - an overview

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This presentation is an overview of the technology developed at AGH University of Science and Technology for time and RF-frequency distribution over optical fibers. The main part of the presentation is a systematic and organized description of the ELSTAB solution, spread in pieces in our previous papers, [1 - 3]. Some new achievements however, not published till now, are also presented.

In the first section the characteristic effects limiting a quality of T&F transfer in optical fibers is described, and various ideas for overcoming this limitations are briefly shown.

Next, the core idea of our system is described, which is an active stabilization of the fiber propagation delay by means of a pair of precisely matched electronic variable delay lines, controlled in a close-loop arrangement - see Fig. 1. Then the time signal embedding is introduced, and time signal delay calibration with its uncertainty budget is presented. The experimental data of a T&F distribution stability are discussed - see Fig. 2.

Then, various extensions of the basic system are introduced. They are: single-path bidirectional optical amplifiers needed in case of large attenuation of an optical path, hybrid electronic-and-optical delay stabilization useful in long-distance links displaying the seasonal delay fluctuations higher than 100 ns, and finally stabilized tapping nodes and side-branches allowing to build a point-to-multipoint dissemination network.

Finally, two field-deployed installations of the ELSTAB system in Poland are described, and general characterization of our technology with reference to other solutions is presented.

Acknowledgement: This work was partially supported by EMRP (SIB-02 NEAT-FT project), NCN (DEC-2011/03/B/ST7/01833 project), and NCBiR (PBS1/A3/13/2012 project).

- [1] Ł. Śliwczyński, P. Krehlik, Ł. Buczek and M. Lipiński, "Active propagation delay stabilization for fiber optic frequency distribution using controlled electronic delay lines," IEEE Trans. Instrum. Meas. vol. 60, pp. 1480–8, 2011.
- [2] P. Krehlik, Ł. Śliwczyński, Ł. Buczek and M. Lipiński, "Fiber optic joint time and frequency transfer with active stabilization of the propagation delay," IEEE Trans. Instrum. Meas. vol. 61, pp. 2844–51, 2012.
- [3] Ł. Śliwczyński, P. Krehlik, A. Czubla, Ł. Buczek and M. Lipiński, "Dissemination of time and RF frequency via a stabilized fibre optic link over a distance of 420km," Metrologia vol. 50, pp. 133–45, 2013.

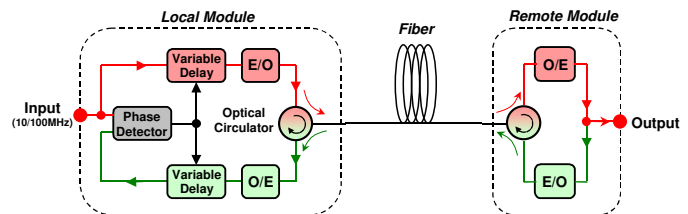


Fig. 1: Simplified block diagram of the delay stabilizing system.

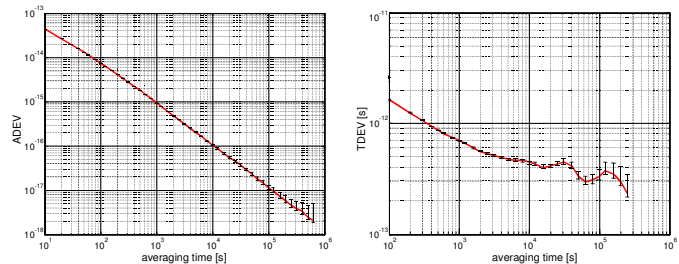


Fig. 2: Overlapping Allan deviation for 10 MHz frequency distribution (left), and Time Deviation for 1PPS distribution (right). Transmission in 60 km-long urban fiber.