

# Fiber-Optic Time Transfer System Based on Self-Developed Components

Zhaohui Wang<sup>1</sup>, Jiameng Dong<sup>1</sup>, Ge Li<sup>1</sup>, Guoqing Sun<sup>1</sup>, Song Yu<sup>1</sup>, Bin Luo<sup>1,\*</sup>

<sup>1</sup> State Key Laboratory of Information Photonics and Optical Communications, School of Electronic Engineering, Beijing University of Posts and Telecommunications, Beijing, China.

Email: \*luobin@bupt.edu.cn

In recent years, the time transfer system based on commercial devices has been widely discussed because of its excellent performance<sup>1,2</sup>. However, due to the rapid progress of the chip industry, many commercial products can be replaced by circuits supported by specific chips. For this reason, self-development of key components in time transfer systems and the integration of corresponding components were carried out. And with the support of self-developed components, modulation-demodulation and measurement-compensation subsystems, which can be applied in time transfer systems, are set up, and related experiments are carried out.

The experiment setup is shown in Fig. 1(a). The output one pulse per second (1PPS) signal of pulse generator (PG, SRS DG645) is divided into three channels by signal distribution module (SDM), respectively to modulation-demodulation subsystem, measurement-compensation subsystem and evaluation subsystem. In modulation-demodulation subsystem, the 1PPS is delayed by electrical delay line (EDL) and modulated by directly modulated laser (DML). The modulated signal passes through the optical circulator (OC) into fiber link and is transmitted to the remote side. In remote side, the signal is fed to the photodetector (PD) for demodulation, and the demodulated signal is transmitted back to the local side in the similar manner. Then, the round-trip 1PPS is used as a stop triggering signal of time interval counter (TIC), and the start triggering signal is the output 1PPS of SDM. TIC1 and EDL are the key components of measurement-compensation subsystem, and the EDL is used to compensate the transmission delay fluctuations of fiber link according to the results of TIC1. TIC2 (Keysight 53230A) is evaluation subsystem. In above system, the key components, including SDM, EDL, DML, PD and TIC1, are self-developed. And the time deviation of proposed round-trip system over 40km fiber link is shown in Fig. 1(b). The short-term stability and long-term stability are 33.24ps@1s and 5.69ps@10,000s, respectively.

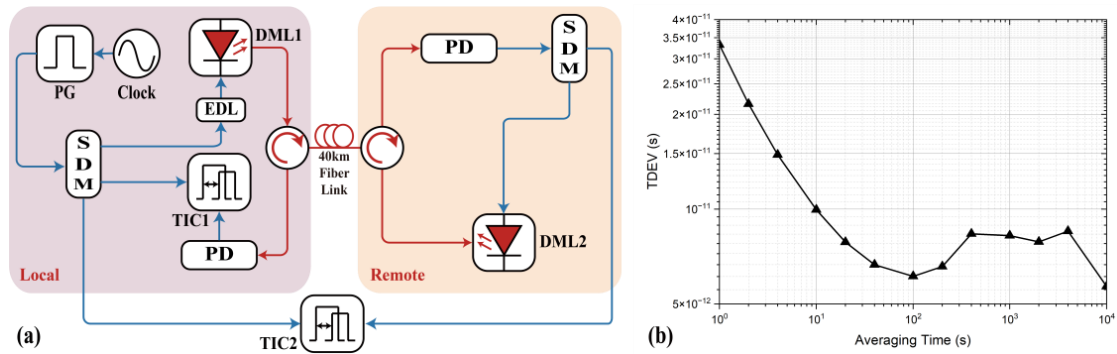


Fig.1: (a). Experiment setup of the proposed fiber-optic time transfer system; (b). the time deviation of the experiment over 40km fiber link.

<sup>1</sup> Wang, B. et al., Sci Rep., vol. 2, 556, 2012.

<sup>2</sup> Han, D. et al., Opt. Lett., vol. 48, p. 5943-5946, 2023.