

Towards accurate optical fibre time transfer in UTC

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At present accurate time transfer is fully based on space techniques. Time transfer via optical fibre will certainly serve to the generation of UTC in the coming future. In particular, Two-way Optical Fibre Time Transfer (TWOTT) is of special interest, since similar to two-way satellite time transfer, it uses the reciprocity in the go and back signals to cancel the path delays.

The first permanent operational time link via optical fiber between the UTC laboratories has been established in Poland, between the Astrodynamical Observatory of Space Research Center (AOS) realizing UTC(AOS) and the Central Office of Measures (GUM) realizing UTC(PL) over a 420 km baseline. The link has been developed in cooperation with the AGH University of Science and Technology in Krakow. The time transfer accuracy is expected to be about 125 ps. One of the advantages of this technique is that the time link is self-calibrated.

Since May 2013, the time transfer data between AOS and GUM have been regularly submitted to the BIPM. However, this data is not yet used at the BIPM for regular time comparisons since a strategy is to be defined by the Consultative Committee for Time and Frequency (CCTF). With the aim of making a comparison of the fibre link with a traditional time transfer technique, the BIPM made on-site measurements using the METODE calibration system.

The measurements served to validate the calibration of the link between UTC(AOS) and UTC(PL) by GPS time transfer using METODE by comparison with the more accurate fibre link. In addition, we present results of the comparison between GPS PPP and optical fibre time transfer for the same baseline.

TWOTT could bring substantial improvement to the UTC generation. The TWOTT can reach tens of ps stability in a few minutes and therefore could provide an effective new tool for the assessment of GNSS and TWSTFT time links calibration. The present structure of international time links relies on time comparisons with a single pivot laboratory, which is not adapted for this new technology. Many fibre links will become operational between UTC contributing laboratories in the near future; this could provoke fundamental change in UTC construction, such as the time link strategy and with a multi-pivot configuration of the UTC time transfer network.

Key words: UTC Time Transfer, Optical Fiber, Two-way Optical Fibre Time and Frequency Transfer (TWOTFT), uncertainty, calibration