

# Calibration of the TWSTFT link between OCA and OP using a GPS link calibration

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The Géoazur time and frequency laboratory in *Observatoire de la Côte d'Azur* (OCA) is one of the rare laboratories to operate three completely independent time transfer techniques. The laboratory has two geodetic-type GPS receivers in operation, one Two-Way Satellite Time and Frequency Transfer (TWSTFT) station and two laser stations used in Time Transfer by Laser Link (T2L2) experiment. In addition, a dedicated T2L2 calibration station has been developed in OCA, which is aiming at providing results totally independent from other techniques. The expanded uncertainty of T2L2 calibration is better than 400 ps ( $k = 2$ )<sup>1</sup>.

In Autumn 2013, the link between OCA and *Observatoire de Paris* (OP) reference time scales was calibrated during a GPS receiver relative calibration campaign based on two traveling GPS receivers of different types. The GPS TAIP3 technique was used for the computation of the link calibration between OP and OCA distribution reference points, eventually leading to an expanded uncertainty of 2.7 ns ( $k = 2$ )<sup>2</sup>.

For various technical and planning reasons, OCA was not able to take part to any TWSTFT relative calibration campaign for many years. Therefore, we decided to calibrate the TWSTFT link between OCA and OP by using the results of the GPS receiver calibration campaign. Same distribution reference point is used for both techniques in remote stations. The TWSTFT differential delays calibrated from GPS measurements were computed with an expanded uncertainty of 3.5 ns ( $k = 2$ ). The resulting uncertainty on the TWSTFT calibration is validated by the coincidence of T2L2 data on the same link, from measurements obtained during a period of time where the portable T2L2 station was implemented in OP.

This calibration data can be used for triangle closures via OP between OCA and other TWSTFT stations.

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<sup>1</sup> E. Samain et al., "T2L2: Ground to ground Time Transfer", Proc. EFTF 2012.

<sup>2</sup> G.D Rovera. et al., "Link calibration against receiver calibration time transfer uncertainty when using the Global Positioning System", submitted to this conference.