White Rabbit network for REFIMEVE

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Scientific endeavors emphasizing enhanced performance and reliability are driving the increasing adoption of fiber-based time and frequency dissemination methods as a viable alternative to GNSS techniques[1]. For these techniques to be deemed feasible on a national scale, the maturity level of the deployed technologies in real-world settings is paramount. This ensures not only the effectiveness of the new service but also its seamless integration into existing active telecommunication networks beyond short-term projects.

Over the past decade in France, a national network for disseminating optical frequencies has been developed alongside the data flow of active telecommunication networks, through the REFIMEVE+ research program. The network's consolidation, geographical expansion, and inclusion of radio-frequency and time transfer capabilities, as well as its outreach to new users, are being financially supported by the ESR+ project T-REFIMEVE.

As part of the T-REFIMEVE project, we aim to implement a nationwide long-range White Rabbit (WR) network utilizing xWDM technology within a unidirectional telecommunication architecture[2]. This plan builds upon our initial investigations conducted on fiber spools employing a cascaded architecture spanning 500 km[3].

To evaluate the performance of the WR network, we established remote monitoring capabilities to track round-trip times across the entire deployed network. This paper will outline the deployment status of our White Rabbit network across 11 laboratories within a 40 km radius in the Paris area, as well as our approach to monitoring its performance using built-in tools, taking advantage of the outstanding resolution capability, as low as a few 10s of ps, of the white rabbit switches.

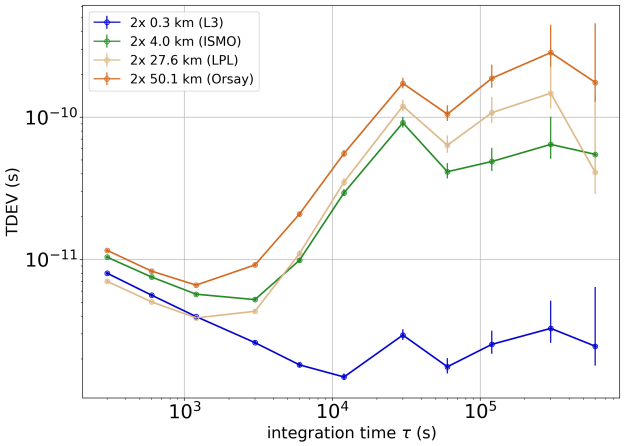

Fig. 1: *Delay fluctuations of the links before compensation over one month as retrieved from the WR engine. In-field links show large diurnal signatures. ISMO and LPL are two laboratories and Orsay is a city in the Paris suburbs. L3 is a short link between two laboratories which are 20 m underground.*

[1] Hansen *et al.*, DOT-VNTSC-20-07, (2021). https://rosap.ntl.bts.gov/view/dot/55765; J. C. J. Koelemeij *et al.*. *Nature* (2022) doi: 10.1038/s41586-022-05315-7

[2] M. Lipiński, *ISPCS* (2011), doi: 10.1109/ISPCS.2011.6070148 ; E. F. Dierikx *et al.*, *IEEE T-UFFC* (2016), doi: 10.1109/TUFFC.2016.2518122.

[3] N. Kaur *IEEE T-UFFC.* (2021) doi: 10.1109/TUFFC.2021.3134163.