

Campus Ku-Band RF Over Fiber utilized for Two-way Satellite Time and Frequency Transfer

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Two-way satellite time and frequency transfer (TWSTFT)¹ is employed by timing laboratories to make regular comparisons between their timescales. In particular the realizations of UTC(k) within the scope of CCTF-K001.UTC are compared by TWSTFT resulting in low systematic measurement uncertainties.

The new TWSTFT-station named SP02 at RISE Research Institutes of Sweden, maintaining UTC(SP) comprises a modem generating and receiving a modulated 70 MHz signal that is subsequently converted to the Ku-band by frequency mixing to allow signal relaying via a geostationary satellite. The front-end of this new ground station is located at a distance from the timing laboratory not easily bridged by coaxial cabling. Nevertheless, a signal link between front- and back-end of the ground station is needed that does not limit the carrier phase performance of the system.

Here is a design and evaluation presented of an RF over fiber (RToF) link transmitting the Ku-band signal between a temperature-controlled time and frequency-laboratory to a remote terminal antenna. Figure 1 outlines the link comprising combined fiber optical sending and receiving units on both ends. Each unit in turn comprises of a laser and an amplitude modulating Mach Zender interferometer on the transmitting side and an RF photoreceiver on the receiving side. Electrical amplifiers align the signal levels.

Performance of the implementation has been quantified and analysed. Results from measurements of the range of the roundtrip with one RToF-link, including back-to-back up- and down converters, between Rx and Tx of a SATRE modem indicate a total short term phase noise of about 10 ps at 20 Mc/s with a few picoseconds stemming from the RToF link.

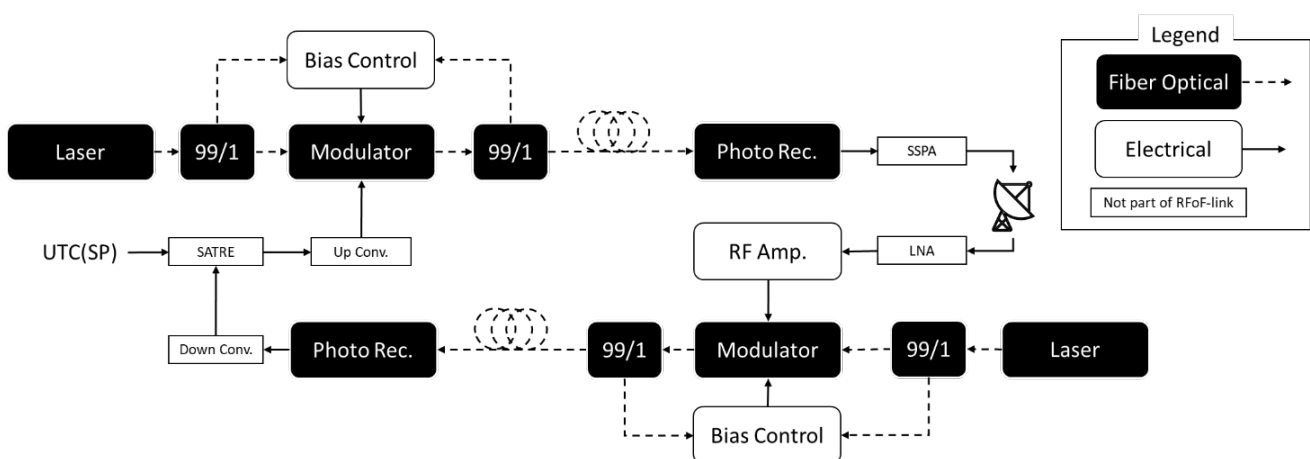


Fig. 1: Schematic drawing of the TWSTFT signal path including RToF link between timing laboratory and antenna.

¹ D. Piester et al. "Time transfer with nanosecond accuracy for the realization of International Atomic Time", Metrologia 45 (2008) 185–198 doi:10.1088/0026-1394/45/2/008