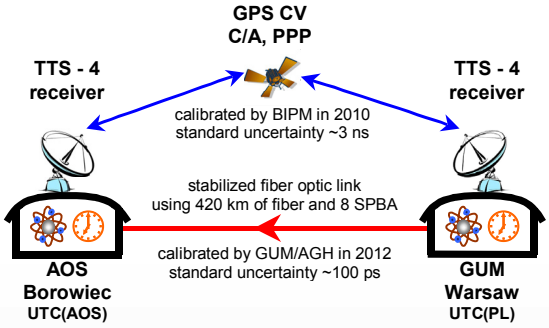
Dissemination of time and RF frequency via long distance stabilized fiber optic link

Ł. Śliwczyński and P. Krehlik
AGH University of Science and Technology, Kraków, Poland

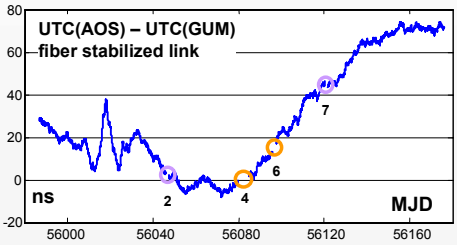
GUM-AOS STABILIZED FIBER-OPTIC LINK FOR T&F DISSEMINATION

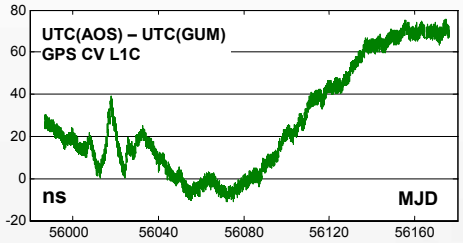
In January 2012 the long-haul system for dissemination of 10 MHz and 1 PPS signals was installed on 420 km long route between the Laboratory of Time and Frequency of the Polish Central Office of Measures (GUM, Warsaw) and the Astrogeodynamic Observatory of Space Research Center (AOS, Borowiec near Poznan). This installation uses dedicated transceivers and bidirectional fiber optic amplifiers (SPBAs) developed at AGH, connected with G.655 and G.652 dark fibers supplied by PIONIER (PSNC) and TPSA.

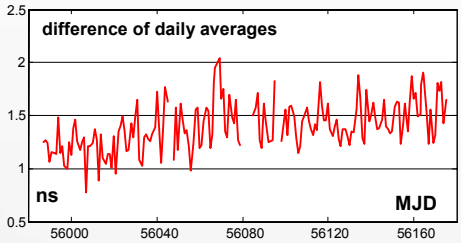
at AOS UTC(AOS) is compared with the remotely delivered copy of UTC(PL). Simultaneously both timescales are compared using two TTS-4 receivers by GPS CV C/A code and PPP methods.



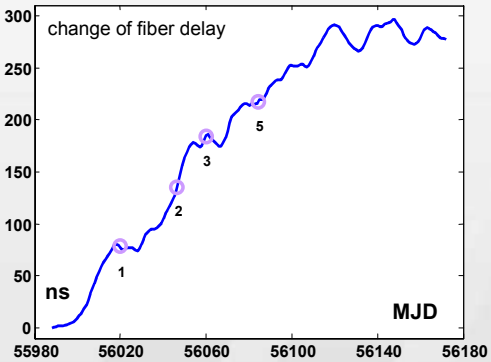
RESULTS FROM SIX MONTHS OF CONTINOUS OPEARTION (February 28 – September 02)







BRIEF HISTORY OF THE LINK



After the launch of the link on January 27 and short phase of initial functional tests, the link was calibrated at MJD 55963. Since then it is continuously used to compare the UTC(PL) and UTC(AOS).

During the operation of the link a number of events occurred, some caused by break of the optical path and some because of limited tuning range of the electronic delay lines used to stabilize the propagation delay.

In current version of developed integrated circuits the tuning range is about 100 ns that is not enough to to cover seasonal fluctuations in 420 km long fiber line. This problem is currently handled by adding or removing manually the fiber patchcords with adequate length. This procedure does not call for recalibration of the link, introduces however a few minutes long discontinuity of disseminated timescale.

MAIN EVENTS

	MJD	description	comment
0	55963	system calibration	$\tau_{GUM-AOS}$ = 2 047 574,25 ns
1	56020	DLL correction patchcord shortened (10 m)	no calibration required
2	56046 - 56047	DLL out of range patchcord shortened (15 m)	no calibration required
3	56076	DLL correction patchcord shortened (10 m)	no calibration required
4	56080 - 56084	optical fiber break	calibration required $\tau_{GUM-AOS}$ = 2 047 351,05 ns
5	56086	DLL correction patchcord shortened (15 m)	no calibration required
6	56096 - 56097	optical fiber break	calibration required $\tau_{GUM-AOS}$ = 2 047 751,05 ns
7	56120 - 56121	optical fiber break	no action required

Activity within the SIB02-REG2 NEAT-FT EMRP Researcher Excellence Grant:

MAINTENANCE-FREE LONG REACH LINK

EMRP
European Metrology Research Programme
Programme of EURAMET
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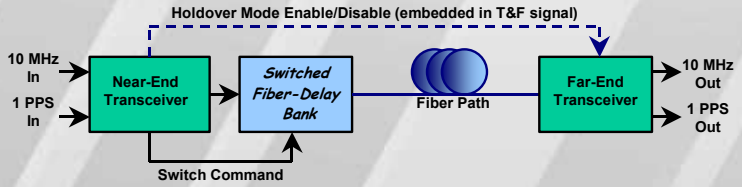

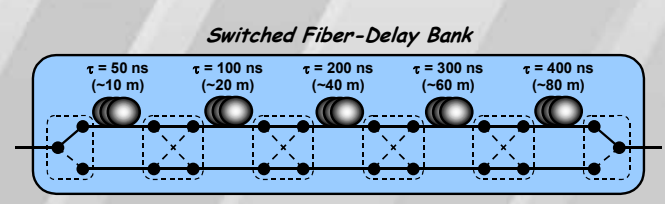

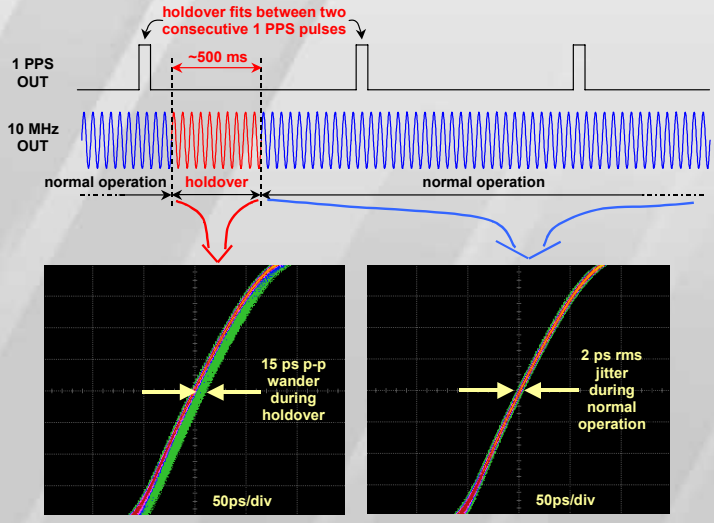

We propose to solve the problem of discontinuity during the phase of adding/removing the the patchcords by driving the OCXO-based dual-PLL in the Far-End Module into the holdover mode for about 500 ms. Entire switching cycle will fit between two consecutive 1 PPS pulses, so the continuity of the timescale is assured.

Proposed Switched Fiber-Delay Bank comprises spans of fibers connected with the optical crosspoint switches. To cover the fluctuations in 1000 km long fiber link the total delay of the Bank should be around 1000 ns, with the delay granularity of 50 ns.

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