Local Differential Calibration Report

Date: 21st Aug, 2019

Introduction: CSIR-NPL India (NPLI), have different GNSS receivers which had calibrated in year 2018 by NICT and BIPM using G2 calibrator (NICT and BIPM Report). Recently, we had GPS rollover issue in LIAA, LIAB and LIT4 receiver. Therefore, to overcome this issue we need to upgrade these receivers. Now, in upgraded LIAA and LIAB receivers Rinex files are uncorrected with delays. After upgrade, we calibrated the receivers with reference calibrated receiver. Here, we used LI2P receiver for local differential calibration of these three updated receivers.

Procedure used: The figure1 shows the setup for GNSS receivers. We used Rinex files of LI2P, LIAA, LIAB and LIT4 receivers for nine days (MJD58701 to MJD58709). The comparison made using DCLRINEX software for different pair of receivers (LI2P-LIAA, LI2P-LIAB and LI2P-LIT4).

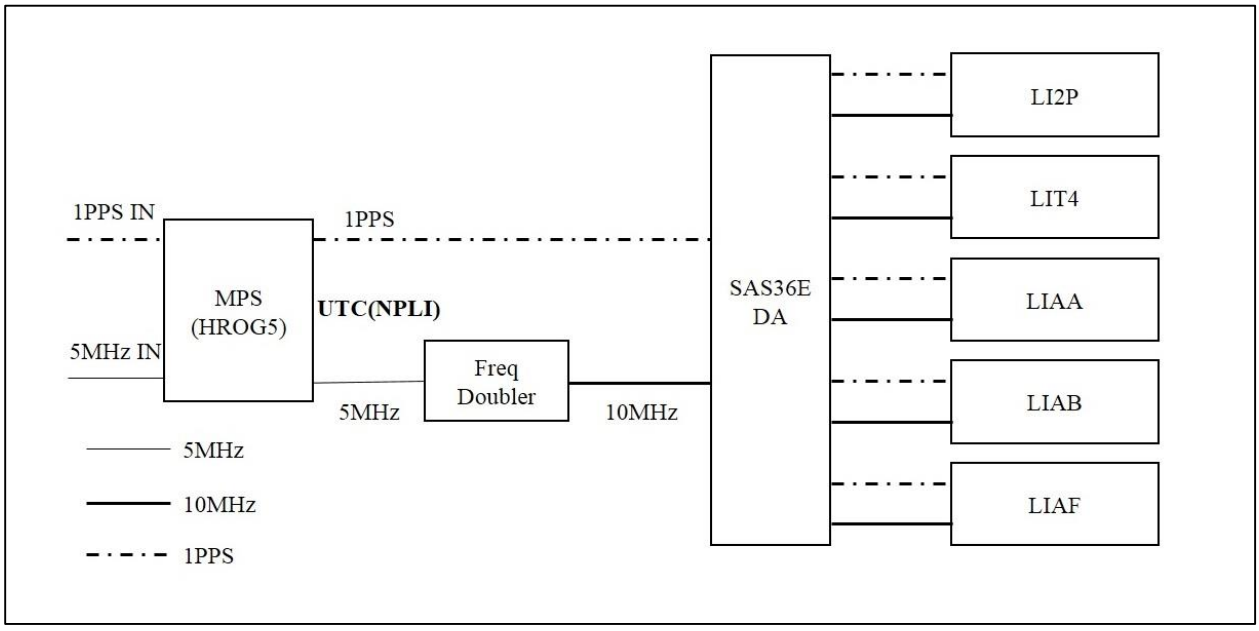

Figure1: Practical Set-up for GNSS Rx

Calculation and Measurement using DCLRINEX: The figure2 to figure4 shows the results of DCLRINEX software. The calculation for IntDly of LIAA, LIAB and LIT4 receivers are as follows:

$$[IntDly]_{(b)}=IntDly_{(a)} - [Med(code) + (RefDly_{(a)} - RefDly_{(b)}) - (CabDly_{(a)} - CabDly_{(b)})] \_ \_ \_ \_ \_ (1)$$

Where:

$IntDly_{(a)}$, $RefDly_{(a)}$, $CabDly_{(a)}$: Delays of LI2P receiver

$IntDly_{(b)}$, $RefDly_{(b)}$, $CabDly_{(b)}$: Delays of LIAA, LIAB and LIT4 receiver

Med(code): Median value by DCLRINEX software

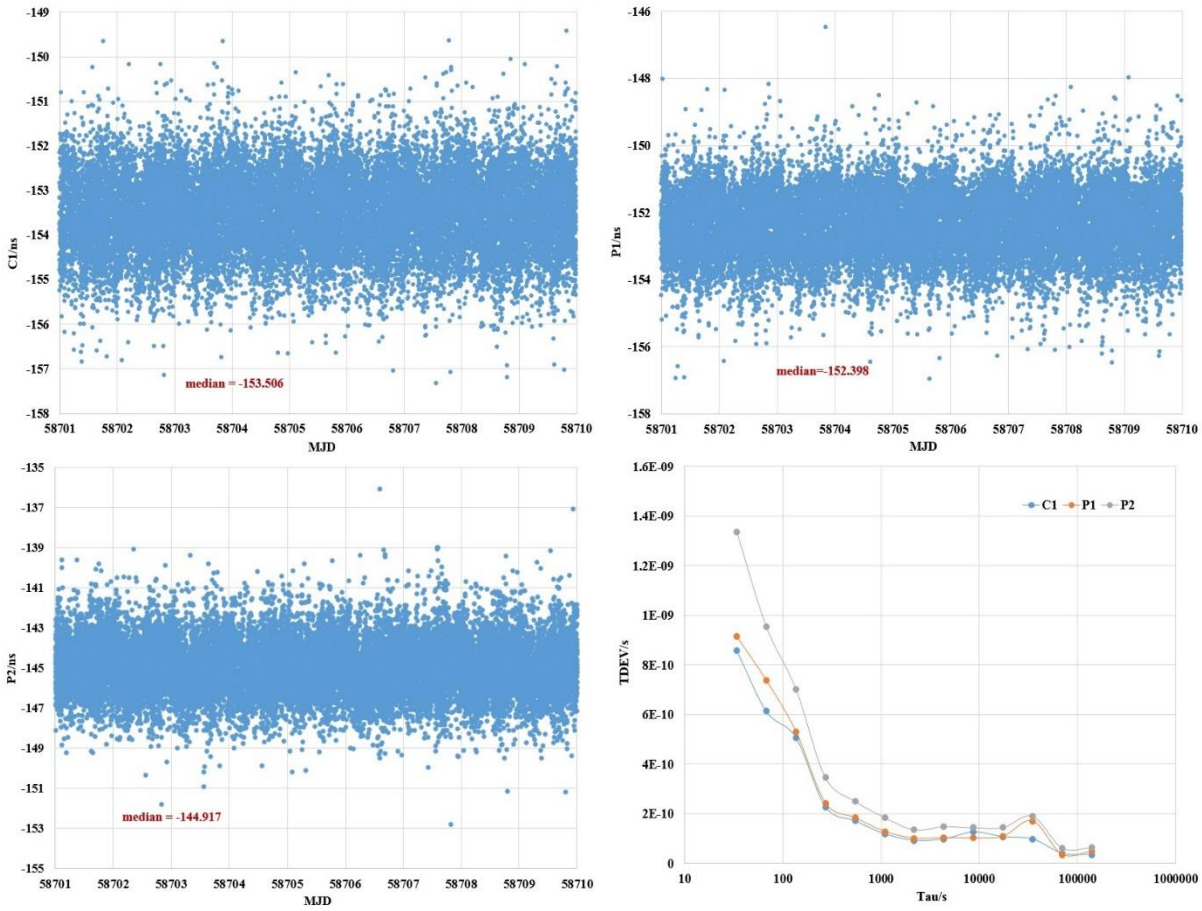

Figure2: C1, P1 and P2 measurement and Allan deviation for LI2P-LIAA for duration of MJD58701-58709

Table1

Receiver ID	RefDly, ns	CabDly, ns	IntDly, ns		
			C1	P1	P2
LI2P	284.1*	150.0	52.9	53.1	58.3
LIAA	96.7	132.9	0.0	0.0	0.0
LIAB	96.5	132.2	0.0	0.0	0.0
LIT4	15.1**	142.2	-24.6	-26.7	-26.6

Note: *RefDly (284.1 ns) is the resultant of (a) UTC(NPLI) to receiver input delay (96.1 ns) and receiver input to output delay (188.0 ns).

**RefDly (15.1 ns) is the resultant of (a) UTC(NPLI) to receiver input delay (96.5 ns), (b) 1PPS-frequency correction delay (-6.4 ns), (c) firmware correction delay (-75.0 ns).

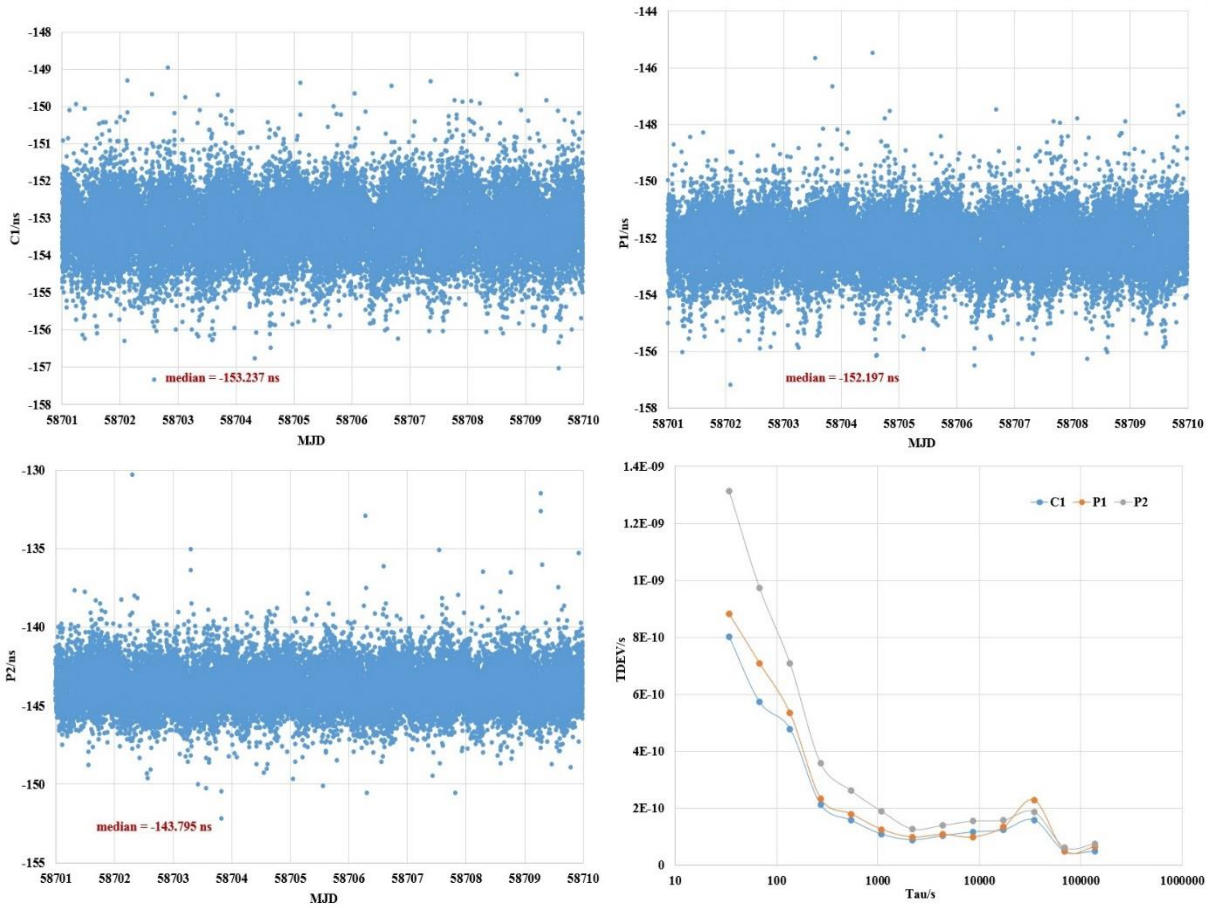

Figure3: C1, P1 and P2 measurement and Allan deviation for LI2P-LIAB for duration of MJD58701-58709

Table2

Receiver ID	Reference Receiver LI2P			IntDly$_{(b)}$, ns		
	Medc1	Medp1	Medp2	C1	P1	P2
LIAA	-153.506	-152.398	-144.917	36.1	35.2	32.9
LIAB	-153.237	-152.197	-143.795	36.3	35.5	32.3
LIT4	-183.851	-181.559	-175.956	-24.4	-26.5	-26.9

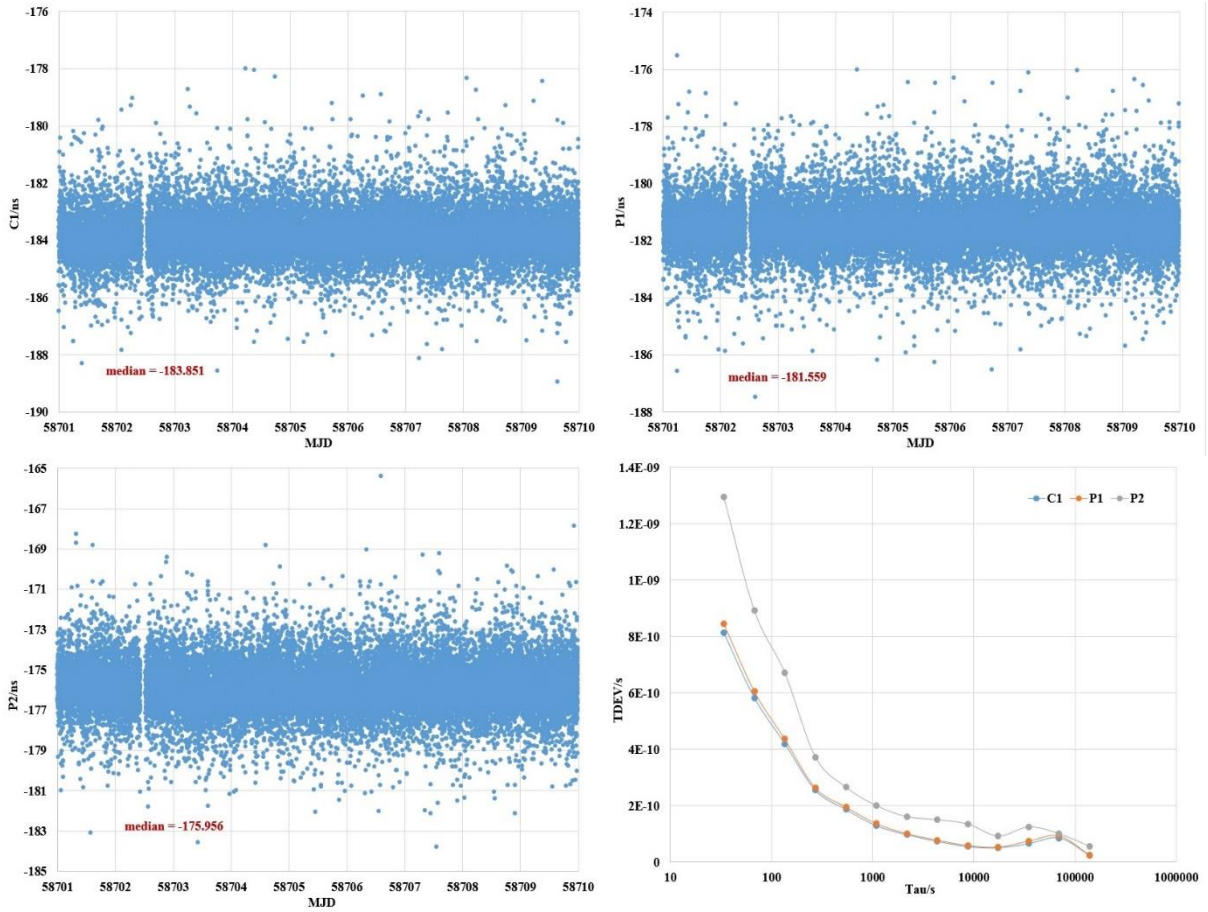

Figure4: C1, P1 and P2 measurement and Allan deviation for LI2P-LIT4 for duration of MJD58701-58709

Conclusion: We made local differential calibration of LIAA, LIAB and LIT4 with respect to LI2P.Table1 shows the present delays in the receivers. The value of IntDly$_{(b)}$ in Table2 shows the calculated values of LIAA, LIAB and LIT4 after calibration using equation (1).

Acknowledgement: We thank to BIPM for DCLRINEX software by which we made calibration and their kind support.