

Variations of GNSS hardware delays and UTC

P. Defraigne¹, G. Tagliaferro², M. Abgrall³, J. Delporte⁴, Z. Jia⁵, S.-Y. Lin⁶, J.-I. Oh⁷, E. Pina¹, C. Plantard⁸,
T. Thái⁹, C. Velez¹⁰, A. Wang¹¹, M. Wouters¹²

¹ Royal Observatory of Belgium, ² BIPM, ³ LNE-SYRTE, Observatoire de Paris, France, ⁴ CNES, France,
⁵ NIM, China, ⁶ Telecommunication Laboratories, Taiwan, ⁷ KRISS, Korea, ⁸ ESA, ESTEC, ⁹ INRIM, Italy,
¹⁰ ROA, Spain, ¹¹ NTSC, China, ¹² NMIA, Australia

GNSS time transfer is the most used technique to compute UTC(k) comparisons between time laboratories, as needed for the computation of UTC. GNSS time transfer performances depend on both the quality of GNSS signals and measures, and the accuracy and stability of the hardware delays in the ground stations. Time laboratories usually maintain several GNSS stations connected to their UTC(k) for redundancy. This allows the BIPM to switch from one station to another in case of data interruption or abnormal behaviour of one station. While the clock solutions of all calibrated receivers should be perfectly aligned, this is however not always the case. As a consequence, the change of receiver in the computation of UTC can induce either the loss of calibration in case the solutions of the two receivers have to be aligned, or an artificial jump in the UTC-UTC(k).

A Task Group of the CCTF Working Group on GNSS has been established in order to quantify the possible hardware delay variations in the current GNSS equipment used by the time laboratories for time transfer, and propose possible strategies to mitigate these variations, as well as their impact on the computation of UTC and on the stability of UTC(k) in case of receiver change in the computation of UTC.

As a first step, we carried out an extensive analysis of available station pairs connected to a same UTC(k) during the period 2019-2023. The clock differences in that case only reveal the changes or variations of the hardware delays. We will present this first step analysis, with a characterization of the different types of hardware delay changes or variations.