Timing performance of GNSS on-board clocks

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The stability of GNSS on-board clocks is a key parameter in the performance of Global Navigation Satellite Systems (GNSS). It is therefore essential to accurately estimate their behavior. The International GNSS Service (IGS) provides with reference orbits and clocks for GPS and GLONASS. For these systems, the performance of the on-board clocks can therefore be obtained using the corresponding IGS clock product in a straightforward way. For more recent navigation systems such as Galileo, BeiDou or QZSS, a multi-GNSS experiment (MGEX) has started in 2011/2012 within the IGS and provides with data and products of some of these systems.

Moreover, we also recently developed a polynomial method[1] to estimate the short term stability of GNSS on-board clocks. It has the definitive advantage to require only a GNSS receiver connected to a ground clock, the performances of which are better than the space clock. It allows to estimate the short term stability of the GNSS on-board clock for a given pass of the satellite over a ground station.

The purpose of this paper is to review and compare the frequency stability of GNSS on-board clocks using the MGEX products and the polynomial method, and to assess the consistency of the results when both methods are available. Furthermore, the timing performance of GNSS on-board clocks in terms of extrapolation error using MGEX clock products will be assessed and compared to expected theoretical performance[2] and to broadcast parameters when available.

[1] J. Delporte, C. Boulanger, F. Mercier, “Short-term stability of GNSS on-board clocks using the polynomial method”, Proc. of EFTF 2012.

[2] F. Vernotte et al. “Uncertainties of drift coefficients and extrapolation errors: Application to clock error prediction”, Metrologia 2001, vol. 38-4, p.325-342.