# PERFORMANCE OF GEODETIC GPS RECEIVERS FOR ON-LINE TIMING APPLICATIONS

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**ABSTRACT**

Multichannel GPS receivers with the hardware output of one pulse per second (1pps) may be used for online applications of time. It may be noted that no serious effort has been made to assess the performance of such GPS receivers for timing in a stand-alone mode. The performances of these receivers have extensively been studied. This paper reports the analyses of these studies and suggests some possible remedial measures to counter these effects.

It has been found that two aspects may tell upon performance of GPS receivers for timing applications. They are: a) the receiver may fail to give its expected accuracy due to lack of calibration of the receiver delay. b) Phenomenon of scintillation may deteriorate the timing accuracy significantly.

To study the aspect of the requirement of calibration, GPS receivers of two different makes have been used. The 1pps from the respective receiver is compared with 1pps of the master clock of NPL, India (NPLI) through a precision time interval counter (TIC) and the results have been stored. The use of the master clock of NPLI [i.e., UTC(NPLI)] has the advantage that UTC (NPLI) can always be correlated with UTC with which GPS time is synchronized.

Timing accuracy and jitter data has been calculated and analyzed. It has been observed that the time available from GPS receivers does not always provide the accuracy as specified by GPS Time. The extent of inaccuracy may not necessarily be the characteristics of that particular model but for that particular piece. Based on the measured data, the frequency stability through Allan deviations have also been studied. These observations dictate that the timing from a GPS receiver needs to be calibrated with respect to any standard clock that is linked to BIPM timing network. Otherwise, absolute accuracy of GPS time cannot be guaranteed. Sometimes it may be necessary to optimize the design of the receiver through calibration. However, frequency stability may be reliable irrespective of the calibration of GPS receive as the presence any unknown but fixed biasing error in timing should not affect the frequency stability.

The effect on time transfer capability by GPS ionospheric scintillation has not been reported before. Recently, through a well planned campaign during peak solar cycle, it has been found that the presence of scintillation may temporarily fades the signals of one or more satellites beyond the threshold limit of the receiver, thereby disturbing PDOP value substantially. This very fact affects the accuracy of the time transfer quite significantly. This paper describes the experimental details and presents the analytical observations of the experiments. The effect of scintillation may be taken care of by proper on-line software that instantaneously corrects the time errors from the knowledge of corresponding position solution errors for a pre-surveyed location.