Extended Abstract

The superior performance of caesium fountain primary frequency standards and secondary optical standards, that now routinely achieve the evaluated uncertainty levels of parts in $1E+16$ and $1E+17$, drives the demand for frequency comparisons at compatible uncertainty levels. In cases where frequency transfer methods do not allow for the use of dedicated fibre links or Two Way Satellite Time and Frequency Transfer due to resources, geography or other operational or physical limitations, the global navigation satellite system and the Precise Point Positioning (PPP) method developed by Natural Resources Canada (NRCan), provide the best widely used and readily available tool [1].

We recently conducted frequency measurement of the single trapped strontium ion optical frequency standard [2]. Our goal was to achieve traceability to the SI second with frequency transfer uncertainty at $1E-15$, while relying on Global Positioning System (GPS) receivers and PPP software. We operated a commercial hydrogen maser and several GPS receivers from a variety of manufacturers in our laboratory at National Research Council (NRC) and we performed frequency transfer analysis using several receivers simultaneously. We observed that results from different receivers connected to the same or different antennas vary by several parts in $1E+16$, differences greater than expected from the statistical noise performance analysis of the data. We performed frequency comparisons using data from several different international labs and compare our results to those published by the Bureau International des Poids et Mesures (BIPM).

We will present the results from multiple tests and extensive analysis we performed to validate our methods. Our results indicate that special care needs to be taken to achieve frequency transfer uncertainty at $1E-15$ level when using the PPP method. Relying just on a single receiver results can lead to a significant systematic frequency shift.

References
