Link calibration against receiver calibration time transfer uncertainty when using the Global Positioning System

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We propose a direct comparison between two different techniques for the relative calibration of time transfer between remote time scales when using the signals transmitted by the Global Positioning System (GPS). In the remote sites, the local measurements are driving either the computation of the hardware delays of the local GPS equipment with respect to a given reference GPS receiver, or the computation of a global hardware offset between two distribution reference points of the remote time scales. This last technique is often called a "link" calibration, with respect to the other one, which is a "receiver" calibration. Both techniques do not require the same measurements on site, hence are not leading to similar uncertainty budgets, and we discuss different related issues. We report on one calibration campaign organized during Autumn 2013 between Observatoire de Paris (OP), Paris, France, Observatoire de la Côte d'Azur (OCA), Plateau de Calern, France, and NERC Space Geodesy Facility (SGF), Herstmonceux, United Kingdom. In addition to two GPS receivers of different types connected to one single antenna plus antenna cable, the OP traveling equipment included a 1 pps signal generator and a 10 MHz distribution amplifier plus a Time Interval Counter, allowing a direct comparison between the link calibration and the receiver calibration performances. We show the different ways to compute uncertainty budgets, leading to improvement factors around 3 on the uncertainties when comparing the relative link calibration to the relative receiver calibration. But a link calibration not only requires more remote site visits to measure properly the closure for each link, but also remains restricted to each given link only. Therefore, the link calibration technique appears mostly useful for an assessment of different time transfer techniques between two clearly identified distribution reference points in two remote stations, common to all techniques involved.

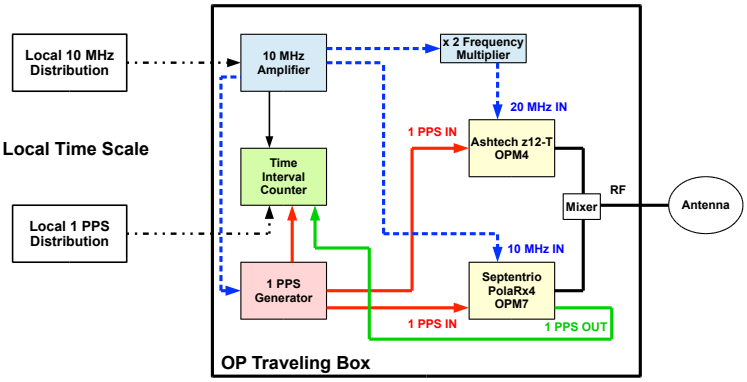

Fig. 1: OP traveling equipment for the OP-OCA-SGF relative calibration campaign. It includes a 1 pps generator, a 10 MHz distribution amplifier, and a Time Interval Counter, in addition to the two GPS receivers of different types connected to the same antenna by a power splitter combiner.