Development of the Industry-Located and Swiss Clock based ETER Timescale System

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A high-availability and high-stability timescale system named "ETER", designed in collaboration between CSEM and METAS for a Swiss industrial partner, is presented. This system, targeting state-of-the-art performances, consists today of two distinct redundant timescales distant by more than 100 km, interconnected by GNSS time comparison in view of their future combination. Each timescale contains four state-of-the-art atomic clocks, exclusively provided by Swiss manufacturers, alongside redundant timing distribution and control.

To optimize temperature control and facilitate maintenance, the two timescales are housed within five racks (Fig. 1). Four racks accommodate an atomic clock each, and a central rack hosts control units and the timing distribution. The atomic clocks chosen for each timescale include an active hydrogen maser from Safran Timing Technologies (iMaser3000), an optically pumped cesium clock (OSA 3300) and a magnetic cesium clock (OSA 3235B) from Oscilloquartz SA. Additionally, a novel rubidium optical atomic clock, in development at CSEM, funded by the industrial partner, completes the clock ensemble.

Fig. 1: 3D generated representation of one timescale composed of five racks. From left to right: OSA 3235B; iMaser3000; Control Unit; CSEM rubidium optical atomic clock; OSA 3300.

As both timescales are located in different cities in Switzerland, distant by more than 100 km, they are linked by a GNSS time comparison. This link could be used in the future to generate a single timescale originating from the ensemble of clocks contained today in both timescales. Significant attention has been directed towards ensuring the optimal performances and reliability of the two timescales and, in particular, of the atomic clocks. The racks are equipped with secured double electrical power supply and highly precise thermal control. Those stringent requirements open the door for a potential participation of their constitutive clocks in the definition of UTC.

During the presentation, the ETER system architecture will be detailed, shedding light on the individual constituent atomic clocks. The timescales algorithms implemented in the control units and their architecture will be outlined, accompanied by an analysis of the timescales stability and accuracy. In addition to the technical advancements, a noteworthy aspect is the procedure established with METAS to consider privately located and maintained atomic clocks for potential participation in UTC generation by the BIPM. This contribution outlines indeed an initiative in the field of timekeeping, with potential far-reaching impacts on the evolution of UTC time generation and global synchronization efforts.