IEEE DL Proposed lecture:

Precise Time Scales and Navigation Systems, the Ultimate Challenge to Time Metrology

Today, atomic clocks enable precision estimates of time and position.
Through the use of ultra precise atomic frequency standards, we can form time scales, such as the international time standard Universal Coordinated Time (UTC), capable of dating events with nanosecond accuracy.
Similarly, Global Navigation Satellite Systems (GNSS), provide location all over the world with sub-meter accuracy.
In timekeeping, as well as in navigation systems, the questions may be similar, but the answers are frequently dissimilar, due to different goals, requirements, technology availability and constraints.
In both cases precision clocks, measuring systems, and a reference time scale are required; in both cases we need to estimate how often the clocks are to be resynchronized and what is the acceptable time error that a clock may accumulate without compromising system performance.
We require a mathematical model to predict clock behavior in order to maintain agreement with another reference clock or to ensure updated navigation messages. We need to understand the "normal" behavior of a clock to be able to quickly identify anomalies which can lead to incorrect estimates.

The lecture presents the needs of precise Timing and Navigation, explaining the current international timekeeping architectures and the timing systems of the current GNSS, giving insight to the most demanding topics that still challenge Time Metrology.