Looking for a Lunar Reference Timescale

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Multiple space missions to the Moon are currently being planned by space agencies and industrials. Positioning, Navigation and Timing (PNT) are expected to rely on lunar equivalents of terrestrial GNSS, which relies on clock comparisons and the existence of a common reference timescale. This triggers the need to define such a reference timescale, and to identify how to implement it in a way that will allow, like on the Earth, effective synchronisation of the clocks involved as well as realization and dissemination of this reference timescale. In a first step, we have to define a Lunar time scale, associated with the Lunar Reference System in a relativistic frame, while keeping the link with our Earth-based time scales, in particular the Terrestrial Time TT and UTC, its realization corrected for leap seconds. We explore some aspects of these questions while taking part to an inter-agency work about the interoperability of systems in cis-lunar environment (LunaNet proposal), which covers many physical and technological aspects of the cooperation between operators of Moon space missions.

In this talk we will present the current status on this topic from the viewpoint of timescales and clock proper times, time transfer on and around the Moon, from the Earth to the Moon. We will also detail the different options for a reference Lunar Time Scale, with their connection with UTC and their advantages and drawbacks.