NEWS! From the
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FOR IMMEDIATE RELEASE

ARE NEGATIVE LEAP SECONDS IN OUR FUTURE?

Coordinated Universal Time (UTC) is the internationally recognized standard for civil time. It is defined by recommendation (460-6) of the International Telecommunications Union-Radiocommunications Section (ITU-R):

> "UTC is the time scale maintained by the International Bureau of Weights and Measures, (BIPM), with assistance from the International Earth Rotation and Reference Systems Service (IERS), which forms the basis of a coordinated dissemination of standard frequencies and time signals. It corresponds exactly in rate with International Atomic Time (TAI) but differs from it by an integral number of seconds. The UTC scale is adjusted by the insertion or deletion of seconds (positive or negative leap seconds) to ensure approximate agreement with UT1."

UT1 is a time scale based on the rotation of the Earth with respect to the Sun and is determined largely by astronomical observations and disseminated by the IERS in the form of tables of daily values of UT1-UTC. By international agreement, UTC is kept within 0.9s of UT1 by the occasional insertion of one-second adjustments called "leap seconds." In practice, the IERS usually calls for a leap second whenever the difference between UTC and UT1 approaches 0.6s. December 31 and June 30 are the first preferences for the dates of leap second insertion, with March 31 and September 30 as secondary preferences. Announcements of the possibility of leap second insertions are issued six months in advance.

A positive leap second is inserted between the UTC second labeled 23:59:59 of the chosen UTC calendar date and the UTC second labeled 00:00:00 of the following date. The extra second is displayed on UTC clocks as 23:59:60. A negative leap second would skip the UTC second labeled 23:59:59 of the last day of a chosen month so that the UTC second labeled 23:59:58 would be followed immediately by the second labelled 00:00:00 of the following date.

Since this definition was implemented in 1972, 27 positive leap seconds have been inserted to date (2021). These adjustments are spaced infrequently. For example, nine leap seconds were inserted from 1972 through 1979, and none between 1999 and 2005.

The reason for the difference in time scales and the variable spacing in leap second adjustment is the changing rate of rotation of the Earth, which cannot be predicted with sufficient accuracy. Causes of these variations in rotational speed include the gravitational effects of the Moon, rise of global sea levels, and rebound of the solid portions of the Earth as glaciers recede. Currently the length of a day, measured by the rotation of the Earth with respect to the Sun, is approximately 0.001 seconds longer than the duration of the day corresponding to 86,400 seconds of TAI. That excess interval would result in an accumulated difference in time of 0.365 seconds after one year of 365 days and call for the insertion of a positive leap second after about two years.

Recent observations indicate that the length of the solar day may, in fact, be growing closer to 86400 seconds of atomic time, indicating that the Earth's rotational speed is increasing over the value of a few years ago. Some might speculate that this may be due to increasing sea level over the planet. In fact, some of the most recent observations indicate that the solar day may actually be *shorter* than 86,400 seconds of TAI. If that trend were to continue it may be necessary to introduce a *negative* leap second for the first time.