Proposal for a new dissemination of time scales

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• Continuous series of \([UT1- TAI]\) for the period 1955-2003 (corrected for secular variation).

• "predicted series " of \([UT1-UTC]\) based on a simple extrapolation over 2 (3) years.

• Analyzed the deviation "real-predicted » data.

• Inconveniences of leap seconds.

• Proposal (personal point of view of the authors)
Continuous series $[UT1-TAI]$ since 1955

- 1955 - 1975: Bulletin Horaire (BIH)
  BIH Annual Report
  - 1955, NPL (atomic time)
  - 1971, International Atomic Time (TAI)

- 1975 - 2003: IERS series EOP C02

Values of UT1-TAI at 5-day intervals
Fig. 3. $UT1-TAI$ corrected for secular variation, in seconds
UT1-TAI corrected for secular variation, in seconds
Prediction of $UT1 - UTC$ over 2 to 3 years

$\text{Rate}_{(-3;-2)}[UT1-TAI]$

$[UT1-TAI](d) = (d-2y) + \text{Rate}_{(-3;-2)} \times 2y$
Fig. 4. Two-year prediction of $UT1-TAI$ (observed - predicted) in seconds
Fig. 5. Three-year prediction of \( UT1 - TAI \) (observed - predicted) in seconds
Why are leap seconds becoming increasingly inconvenient?

- Growing need of a continuous time scale;
- \([UTC - TAI]\) increases at irregular intervals;
- ambiguous dating in UTC at the moment of occurrence of the leap second;
- frequency of occurrence of (positive) leap seconds will increase in the long term; decade fluctuations of the Earth ’s rotation may lead to 2 leap seconds per year;
Fig. 9. Number of leap seconds per year
Why are leap seconds becoming increasingly inconvenient?

• Growing need of a continuous time scale;
• \([\text{UTC} - \text{TAI}]\) increases at irregular intervals;
• ambiguous dating in UTC at the moment of occurrence of the leap second;
• frequency of occurrence of (positive) leap seconds will increase in the long term; decade fluctuations of the Earth’s rotation may lead to 2 leap seconds per year;
• the present situation favours the proliferation of time scales (GPS, GLONASS, GALILEO).

consequently...
... 

- adoption of a continuous, world-wide time scale (or at least continuous for several centuries);

- single change;

- users should be given enough time to get adapted to the new situation before application;

- during this period of preparation UTC should be kept as it is.
## Possible solutions

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<td>(continuity is assured)</td>
<td>(discontinuous in the very long term)</td>
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- TAI should be the world-wide time scale (renamed TI);
- step to UTC to align it to TAI at the moment of application;
- legal times based on TAI by correction of an integer nb. of hours (system of time zones at present not fully respected).

- TAI should be preserved as it is; UTC should be maintained but under a new definition;
- interrupt the application of leap seconds to UTC, add a leap hour in the far distant future (2600?)
- legal times continue to be based on the new UTC.

ITU-R SRG Colloquium on the UTC Time Scale  
Torino (Italy), 28 - 29 May 2003
Access to UT1

• dissemination of data depending on UT1 is essential;

• annual ephemerides (1 s precision) based on a prediction of $\Delta$UT1-TAI the time argument being
  – TAI (proposal I)
  – UTC (proposal II)

• IERS (or any responsible authority for monitoring Earth rotation) should predict $\Delta$UT1-TAI for the ephemerides;

• for other needs of UT1 dissemination of values of
  – $\Delta$UT1-TAI (proposal I)
  – $\Delta$UT1-UTC (proposal II)
    either predicted for real time or observed for deferred time.